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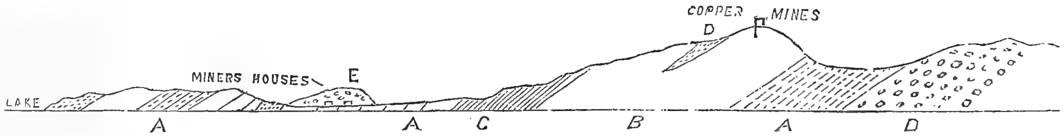
SECTION AT MAIMANSE BAY.



(**A**) Amygdaloid and Tufa.

(**B**) Compact Trap and Amygdaloid.

(**C**) Altered Argillo—arenaceous Rock.

(**D**) Conglomerate.

(**E**) Conglomerate, off line of Section.

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NATURALIST AND GEOLOGIST.

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ARTICLE I.—*On the Geological Structure and Mineral Deposits of the Promontory of Maimanse, Lake Superior.*

BY J. W. DAWSON, A. M., F. G. S.

(READ BEFORE THE NATURAL HISTORY SOCIETY OF MONTREAL, FEB. 10, 1857.)

The Copper Districts of Lake Superior have been so frequently explored and described, that little interest may attach in the minds of many to the subject of this paper. I have selected it, because the locality referred to, though shortly noticed in the Reports of the Canadian Survey, has not hitherto attracted any very large share of attention, and in the hope that to a new observer even th.. ..atures common to this and the better known copper districts of the region, may have presented themselves in some new aspects.

On the North Shore of Lake Superior, the geologist observes between Sault St. Marie and Maimanse, portions of the three oldest formations in America or in the world.

1st. Those beautiful red and spotted sandstones so well seen in the excavations of the Sault St. Marie Canal, and regarded by most geologists as the equivalent of the Potsdam sandstone of New York and Lower Canada, the base of the Silurian Series in America.

2nd. An enormously, thick formation of Conglomerate, Sandstone, Slate, and Trap, evidently lying at the base of the red Sandstone, and constituting the Huronian Series of Sir W. E. Logan.

3rd. The still older Laurentian Series, represented here principally by Syenitic rocks, which have afforded the materials of the Huronian Conglomerates.

The two latter groups of rocks are first seen at Gros Cap. The nucleus of this lofty promontory consists of reddish Syenite, here projecting to the South West of the ordinary limit of the formation to which it belongs, and running down in abrupt precipices into the lake, while around its Western side are wreathed sheets of trappean rock, similar to the cupriferous traps of other parts of this coast, but here containing only veins of calc spar and sulphate of barytes.

Gros Cap is a place to be remembered by a tourist from the eastward. Its bold front, against which the waves break like a sea swell, the picturesque coves cut into the trap of its western side, the singular and rich flora, depending in part, no doubt, on the peculiar climatal conditions of the region, and in part on the character of the rocks,—all contribute to make it the beau ideal of a voyageur's camping ground, and a fitting introduction to the bold scenery of the north shore of this great inland sea.

Crossing Goulais Bay, which cuts deeply into the land, immediately west of Gros Cap, we pass a low shore, presenting no rock sections, but exhibiting in the bottom of the lake, red and white sandstones, like those of Sault St. Marie. At the head of Goulais Bay, Sir W. E. Logan has observed these to rest on the continuation of the trap of Gros Cap.

The next indentation is Batcheewanung Bay, beyond which, after passing a low gravel point, we find on the west side of the small inlet, called Anse aux Crepes, a series of rocks, which, if not forming an underlying member of the Potsdam sandstones, must be of Huronian age.

They consist of imperfectly laminated red and mottled sandstone, a mottled argillo arenaceous rock, having a marly appear-

ance, but not calcareous and possibly a mixture of sand and volcanic ash; conglomerate with syenitic pebbles; laminated tufaceous beds, made up of volcanic ashes and scoriae; and beds of amygdaloidal trap. They dip at high angles to the southward, but very irregularly; the dips observed along a small extent of shore varying from S 10° E to S 70° W. At one part, they are traversed by a thick dyke of trap, in contact with which the sandstones are changed into coarse banded jasper.

An observer approaching these rocks from the eastward, must at first sight, form the opinion that he has reached a lower member of the red sandstone series of the lake, modified by the proximity of rocky coasts and contemporaneous and subsequent igneous action. A geologist familiar with the red sandstones of other regions and periods, would be the more inclined to adopt this view, from the circumstance, that the coating of white sand with peroxide of iron to form red sandstones, has usually, if not always, been a secondary consequence of volcanic action; and hence, the association of red sandstone with trap and tufa is very frequent. For this reason, the appearance of the red rocks of Sault St. Marie would alone be sufficient to prompt the question—are there, in the continuation of these beds, any evidences of contemporaneous volcanic action?

On the other hand, the high inclination and disturbed condition of these rocks, render it not improbable that, as Sir W. E. Logan has shown to be the case with the somewhat similar rocks on the north side of Lake Huron, they uncomformably underlie the Potsdam sandstone, which in that case may be in part made up from their waste.

The promontory of Maimanse is high and rugged in its interior, and in approaching from the east, its outline presents a series of abrupt protuberances. This appearance is caused by the outcropping edges of thick beds of trap and conglomerate, which have, better than the associated tufa and sandstone, resisted the denuding agencies, which in this region appear to have most thoroughly swept all the elevated tracts, scooping out the soft beds and carrying off all the finer materials, as if the forces of breakers and strong currents had been combined in the operation, along with the drifting agency of ice.

In a point at the west side of Anse aux Crepes, the beds of sandstone and trap are seen in a less disturbed state than in the bay itself. Two very thick beds of amygdaloidal trap are here

exposed, and between them are bands of brown ripple-marked sandstone and volcanic tufa. The whole dip west at an angle of 15°. The amygdaloids are evidently superficial lava currents, presenting in some places those pipe-like cavities described by Sir W. E. Logan in his account of this place, and which must have been caused by air bubbles rising through the superficial molten mass. The amygdaloid is much more vesicular above than below, and its cavities and veins are filled with agate, crystalline quartz, calc spar, and flesh-coloured laumonite.

The shore for some distance follows the strike of these beds, in which the waves, acting on the tufa and mineral veins, have excavated many small caverns and ravines. Some of these excavations are at a little higher level than that of the waters of the lake at present: and they are very instructive in the explanations which they afford of erosions observed even on the summits of the hills.

Five miles westward of Anse aux Crepes, the ledges of the coast are broken across, probably along the line of a transverse fracture of the beds, to form the little bay of Maimanse. On the east side of this bay, we find another section of trappean and sedimentary rocks, apparently a little lower in the series than those of Anse aux Crepes. The highest bed of trap is amygdaloidal above, and more compact below, where it rests upon a brown conglomerate with syenitic pebbles, and thin layers of brown sandstone. The latter consists of grains, often rounded, of quartz, felspar, and hard black slate, stained by peroxide of iron, and cemented by carbonate of lime, which also enters into the cement of the conglomerate. The conglomerate rests upon another bed of trap, which in its upper part is largely amygdaloidal, and contains small agates. It also holds syenitic fragments, probably mixed with the scoriacous matter of its surface, at the time when the conglomerate was deposited above, so that, as is often seen in such cases, the upper part of the trap passes into the conglomerate. These rocks present no appearance of igneous alteration subsequent to their deposition, and dip S. 70° W. 35°.

At the head of the bay, and at its western side, the sections show alternations of compact and amygdaloidal trap and hardened volcanic ash, in very regular layers; and holding numerous veins of Calc Spar, Laumonite and Quartz, with small quantities of Epidote, Prehnite, Sulphurets and Carbonates of Copper, native Copper, native Silver, and Galena; the mode of occurrence of

which will be noticed hereafter. The numerous alternations of thin sheets of trap and tufa that appear in the low ground around this bay, indicate a long continued series of submarine volcanic overflows, while the rounded pebbles in the conglomerate point to a rocky Laurentian shore at no great distance. Much remains to be done in this region in separating those igneous beds which have consisted of volcanic ash and scoriæ, from those which are properly trappean; but this is rendered very difficult by the consolidation of the fragmentary beds by zeolitic matter, and by the resemblance which hardened volcanic mud and beds of vesicular scoriæ bear to true overflows of amygdaloidal trap, as well as by the changes induced in true igneous rocks by the percolation of water.

At the head of the bay, the ground rises rapidly to a height of 300 feet, in a succession of steep ridges, representing the outcrops of the beds which succeed each other in descending order. The section from the N. W. extremity of the bay inland is as follows, the measurements being taken from a plan prepared by Mr. Coatsworth of the Bruce Mines, for the Montreal Mining Company, who are now carrying on works of exploration at this place. The dips are to the westward, the general strike being N. 10° to 20° W., and the angle of dip varying from 25° to 35°. The rocks are, as usual with such materials, very unevenly bedded. (See section.)

1. Alternations of trap and tufa, with a bed of conglomerate, which appears to run out a little to the westward of the line of section, in which it does not appear. Large veins of calc spar, quartz, and laumonite occur in the trap, and some of them contain small quantities of native copper, native silver, and galena. Native copper also occurs in the vesicles of one of the amygdaloids, and one thin bed has its vesicles filled with a steatitic mineral. These rocks occupy a breadth of 500 yards.

2. Argillo-arenaceous beds, in places baked into a compact jaspery rock of a fawn colour, with red dendritic stains, in other parts a mottled argillaceous sandstone, similar to that of Anse aux Crepes. Breadth 220 yards.

3. Crystalline and Amygdaloidal Trap, with a bed of conglomerate. These rocks occupy a breadth of 440 yards, and rise to an elevation of 300 feet. The old Indian workings and the excavations of the present mine are on the summit of this ridge. The lowest rocks of this band are probably tufacous, and have been excavated into the ravine of a small brook.

4. Very coarse syenitic conglomerate, forming a second ridge. Some masses of stone two feet in diameter, were observed in this bed. It occupies a breadth of 160 yards.

The thickness represented by these measurements may be about 2,000 feet; but this by no means includes the whole thickness of similar rocks developed at Maimanse, and which extend both above and below the beds above described. The total thickness seen at Maimanse, is estimated by Sir W. E. Logan at 10,000 feet.

The beds included in No. 3 of the above section, are those in which the principal indications of copper have been observed. On the summit of the ridge, the hard semi-crystalline trap is traversed by a narrow fissure, running nearly with the strike of the beds, or north and south. Its greatest thickness is about 6 inches, but in some places this has been found to be nearly filled with native copper. One mass weighing 600 lbs. has been extracted, and the whole yield of a shaft 27 feet deep and without galleries, has been about three tons. The veinstones here are principally calc spar and quartz.

At a short distance westward of the shaft, the vein is divided into two branches. The course of this vein, as well as of most others in these hills, is marked by surface trenches, usually called "Indian diggings," though they are evidently erosions similar to those which run along the veins seen on the present beach, and excavated when the surface was undergoing denudation under water. These trenches, however, afford excellent guides in tracing the veins, and they have served this purpose to the ancient Indian miners, in whose time it is likely that plates of metallic copper, exposed by the removal of less resisting materials, may in places have projected from the bottom of these furrows. The real Indian diggings are shallow holes, sunk at intervals along the courses of the veins, and surrounded by broken pieces of veinstone, along with which are occasionally found stone hammers. These hammers are merely beach pebbles, usually of trap, and having shallow grooves worked around them, to receive withes or thongs used as handles. Most of them are 5 or 6 inches in their longest diameter, but one, now in the collection of the Geological Survey, is about a foot in length.

About one hundred yards northward of the shaft just mentioned, excavations have been made at the intersection of two veins, one running NW. and SE., the other N. and S. The

former is unproductive; but the latter, which is six inches in width, contains small bunches of purple copper, in a veinstone of quartz and calc spar. A few small crystals of copper pyrites have also been observed in it. About 30 yards eastward from the second opening, is another vein, running E., 20° N., and wider than either of the others. Its principal mineral contents are green carbonate of copper with a little vitreous copper and copper pyrites. A few minute specks only of native copper have been observed in it. It appears to be very irregular in its width, and at the place where it has been opened, the wall on one side consists of amygdaloid, and that on the other, of compact trap, probably in consequence of a fault.

It would appear that this ridge is traversed by a multitude of fissures, containing copper and copper ores, and as is generally the case with such veins in trap, very irregular in course and dimensions. Those above described, are the most considerable yet discovered. Their value as deposits of copper, is not yet determined; but the indications are of sufficient promise to warrant works of exploration. The quality of the veins will, no doubt, change as they penetrate the underlying tufa and conglomerate, though, whether in the direction of greater or less value, is uncertain.

As the mode of deposition of native copper has been a subject of much controversy, I examined with care, with the aid of Mr. Borron, of the Bruce Mine, the veins exposed at Maimanse; and shall state the results at which I have arrived for that locality, with the facts on which they are based, without meaning to assert that the mode of occurrence and formation of native copper must, in all cases, have been of similar character. The veins traversing the trap of Maimanse have been filled with successive deposits of mineral matter on their sides, in the manner of ordinary mineral veins. In the larger veins, these are alternate layers of quartz and calc spar, the latter often moulded on the crystalline surfaces of the former, and *vice versâ*. In several cases, the first deposit of quartz is of an agatiform character and stained by peroxide of iron, but the greater part both of the quartz and calc spar is crystalline and colourless.

The deposition of the native copper has evidently been contemporaneous with or subsequent to that of the quartz and calc spar. The larger masses are imbedded in calc spar, occupying the cavities left in the wider parts of the vein, after its sides had

been coated by that mineral. Smaller masses occur in a similar relation to the quartz. In one of the beds of amygdaloid, are kernels of copper impressed by crystals of zeolite, which had lined the vesicles previously to the deposition of the metal. In one small vein, plates of copper cut across the veinstone of quartz. Such examples indicate deposition of copper after that of the veinstone. In other specimens, delicate arborescent crystals of copper penetrate calc spar crystals in such a manner as to give them a general red color, indicating contemporaneous deposition.

Fig. 2 exhibits a magnified view of a thin slice of this cupriferous calc-spar, in which the crystalline laminæ of copper remind one of the quartz plates in graphic granite, and have evidently in part conformed themselves to the structure of the calc spar.

Fig. 2. *Slice of cupriferous calc spar from Lake Superior; magnified* 20 *diameters. The fine straight lines indicate the cleavage; the dark lines the laminae and fibres of copper.*

Native silver occurs on the shore in small quantity, in similar dendritic forms, in a vein containing calc spar, zeolites, and fragments of trap. The sulphurets of copper occur in precisely the same relations with the native metal. The carbonate is probably a product of oxidation of vitreous copper and native copper near the surface of the rock.

The whole of the appearances indicate that the deposition of copper belongs to the period of aqueous infiltration, by which the veins and vesicles were filled after the consolidation of the trap; and the copper, like the calc spar and zeolites, occurs both in true veins and in the cavities of beds of vesicular trap and tufa. Its deposition must, therefore, be explained, not by igneous causes,

but by electro-chemical agencies, decomposing some soluble salt, most probably the sulphate, of copper. Such changes may have been aided by the remaining heat of portions of the volcanic masses, by the presence in them of large quantities of iron in low states of oxidation, and by the further oxidation of that metal evidenced in the red jasper and red laumonite of the veins, and the red conglomerate and sandstone associated with the trap.

One great difficulty in supposing the electro-chemical deposition of copper in these veins, is the want of a conducting surface, and one not likely to be acted on by copper salts, for the commencement of the process. Much of the copper, however, even when not exposed to atmospheric action, is coated with suboxide of the metal; and I have, in several instances, observed the crystals of calc spar in these veins varnished with a thin coat of peroxide of iron, or of suboxide of copper, which has been precipitated on their surfaces, and might have formed a better basis for copper deposition than the naked surface of the calc spar. In the delicate dendritic forms, the crystallization has evidently commenced from minute points; and this may have been the case also with some of the larger masses, which often have thin plates or fibres connecting them with the wall of the vein. Such connecting threads, if first deposited, may have served as conductors.

Such attempts at explanation must, however, in the meantime, be regarded as merely conjectural; and it must be confessed, that we can have little accurate conception of the processes that may go on in fissures extending from the bottom of the sea far downward into volcanic masses, and in which a great variety of substances are subjected in different degrees to the combined influences of heat, pressure, and aqueous solution. The main fact in relation to the origin of the metallic copper, is that it is a product, not of the fusion of the trap, but of subsequent processes, by which the fissures of that rock were filled by materials regarded as of aqueous origin.

In some specimens collected by Mr. Pilgrim, of Sault St. Marie for the Montreal Mining Company, in other locations on the north shore of Lake Superior, and with which I have been favoured by the officers of the Company, I find the following modes of occurrence, which farther illustrate the above views.

One of the specimens (17 of the Company's collection) is a portion of a vein of calc spar and agate with dendritic copper, traversing both minerals. The wall of the vein appears to

be a reddish tufa, with fragments of green trap. Another (12) has a nugget of native copper, imbedded among calc spar crystals, coating a cavity in partially decomposed greenish trap. Another has a thin plate of native copper, running through the centre of a narrow vein of red laumonite. Another (22) is a vein of calc spar and datholite in a reddish tufaceous rock. The datholite occupies the interior of the vein, with calc spar on both sides, and contains crystalline granules of copper, with a little green carbonate of the metal. Another (19) has plates of native copper, moulded into the crevices between crystals of quartz and calc spar, in the cavities of a peculiar pseudo-porphyritic rock, which may have been a mechanical aggregate of felspathic fragments and volcanic ash. Another has small grains of copper attached to crystals of green prehnite, and moulded into cavities left by botryoidal concretions of that mineral. In many specimens accompanying the above, vitreous and purple sulphurets of copper and galena occur in associations precisely similar to those of the native copper.

The age of the cupriferous rocks of Lake Superior has been a subject of much discussion; and my observations do not bear on this subject any farther than to convince me that the rocks seen at Maimanse underlie the red sandstone of Goulais Point and Sault St. Marie. From the observations of Logan, Owen, Foster, and other geologists, I have, however, little doubt that these last are really the equivalents of the Potsdam or Calciferous sandstones; and on this view I have proceeeded throughout this paper.

The Maimanse rocks are assigned by Sir W. E. Logan to the geological horizon of the beds of the Bruce Mine and other places on the north shore of Georgian Bay, as a portion of his ante-silurian Huronian system, which, in the last mentioned locality underlies uncomformably the lowest Silurian rocks. This unconformability has not, so far as I am aware, been observed in Lake Superior; but I should not be disposed, in the case of formations without fossils, and similar in their sedimentary beds, to attach much importance to it; unless indeed it can be proved, that the red sandstone of Sault St. Marie is of much later date, and has been formed out of the waste of the older Maimanse rocks. The appearances rather indicate a great continuous series of sedimentary and volcanic rocks, in some places presenting only fragmentary debris, in others intermixed with volcanic ejections; and perhaps locally broken up by volcanic action, before the close of the process of deposition.

Whatever their precise age, it cannot be doubted that the cupriferous rocks of Maimanse occupy the same position, in relation to the older Laurentian and newer Silurian series, with the Huronian beds of Georgian Bay, and that they also bear a certain general resemblance to them in mineral character.

The red sandstone of Maimanse is represented at the Bruce Mines by quartzite; the conglomerate by a rock with similar pebbles, but much more indurated; the calcareous sandstone by arenaceous limestone. Veins of copper occur at both places; but at Maimanse, native copper prevails, while at the Bruce Mines, the sulphurets alone occur; at Maimanse, the veinstone is mainly calcareous, while at the Bruce, it is mainly silicious. The trap and tufa of Maimanse are at the Bruce represented by greenstone. While the Bruce sedimentary rocks may thus have originally been similar to those of Maimanse, they have been far more altered, and are associated with the deep-seated crystalline products of volcanic agency, instead of with those that are superficial. Differences of this kind imply, however, no difference in age.

These Huronian rocks, including under that name both those of Maimanse and Georgian Bay, mark a long continued period of igneous action and mechanical degradation, proceeding along the coasts of that old azoic land, which formed the nucleus of the American continent. This great series of physical operations constituted the preparation for the Silurian period, and no doubt formed the sea bottoms on which its sea-weeds and shell-fish began to live. In Lake Superior, we have the deposits of the shore margin only of these old seas; what may have been proceeding in their profound depths, we know not, nor have we any information as to the occurrence in their more tranquil waters, or on the neighbouring land, of any form of animal or vegetable life; and the rocks themselves are not of a character to warrant any very sanguine hopes of the discovery in them of organic remains. In a geological point of view, they merely inform us, that at the dawn of the Silurian period, and immediately before the deposition of the oldest rocks in which we find animal life, there occurred along the sea margin of this most ancient part of the American continent, enormous volcanic outbursts; and that these very closely resembled in their character the volcanic phenomena of every succeeding geological period, and even of modern times; and were associated with the extensive deposition of beds of red sandstone and conglomerate, similar to those which, at various

succeeding epochs, have accompanied great volcanic outbursts and physical changes of the earth's crust. In an economical point of view, the great extension of these rocks, and their penetration by veins of copper, give them an importance which must constantly increase as they become more accessible, and are more fully explored.

ARTICLE II.—*Remarks upon the Geographical Distribution of the Order Ranunculaceæ, throughout the British Possessions of North America.* By GEORGE BARNSTON, ESQ., of the Honorable Hudson's Bay Company.

(Communicated to the Botanical Society of Montreal, Dec. 5th 1856.)

The Ranunculaceæ,* form a somewhat extensive order and make a good deal of show among the herbaceous vegetation of North America, although Europe can boast of possessing a greater number of species, the proportion being nearly as 7 to 5 in its favor. These generally hardy, and often beautiful floral inhabitants of the country, frequent the edges of our forests, our river and lake banks, and the rich natural prairies or lawns, that are scattered in such abundance over some portions of the continent. They climb to the mountain tops, and descend to the deepest dells. One species of Anemone is found like a primrose or crocus courting the snows on the great western ranges, and the Hepatica triloba may be spied out in Canada, concealed in the hollows of the most secluded glens. The order also maintains great freedom, in its choice of diversity of soil. We have the Aquilegia Canadensis on the warm slopes of rock and gravel, declining to the southward, while the Ranunculus Sceleratus, Abortivus &c., seek the damp and spongy meadow. The Ranunculus Aquatilis, still more thirsty in its propensities, will be pleased with nothing less than several feet of pure water.

In commencing my observations more particularly upon the distribution of the genera, I may state that I adopt the sequence in which these occur in Torrey's work on North American Botany, it being better to assume some method, however destitute of exact relation to my subject, than no method at all. For it will perhaps be the opinion of the most able in Botanical Science, that Flora, in the distribution of her Ranunculaceous

* For the information of the general reader, it may be remarked that, under the modern systems of classification, the *Ranunculaceæ* form the first Natural order of Flowering Plants. They constitute a very numerous family, characterise a cold damp climate, occupy an extensive range

favors, has attended very little to system or plan, rather seeming to have tripped about with this order in the most discursive and sportive manner. We may imagine her to have been in her

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of country in Europe and North America, and, when met with in the tropics, are found chiefly on the sides and summits of mountains. They vary much in form, and even in the structure of the flower, but they possess certain important characters in common, which admit of their being readily classified under one order. They are herbs or rarely shrubs, possessing an acrid watery juice, and having leaves generally much divided and with thin stalks more or less dilated and sheathing. The flower is variable in form and size, and, in many of the plants, its parts are very anomalous. These anomalies, however, may be generally looked upon as mere modifications, occurring during the progress of development, and in no way diminish that important anatomical resemblance in structure, which may be traced throughout the whole order.

The two following figures illustrate the general characters of the flower, as exhibited in the Ranunculus.

Fig. 1.

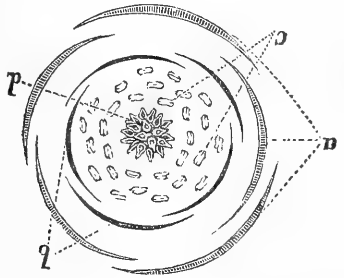


Fig. 1. Diagram of flower of Ranunculus, showing *a.* an outer whorl of 5 floral leaves, called *Sepals; b.* an inner whorl of 5 floral leaves, called *Petals; c.* an indefinite number of *Stamens; d.* numerous *carpels* in the centre, each containing a single seed.

Fig. 2.

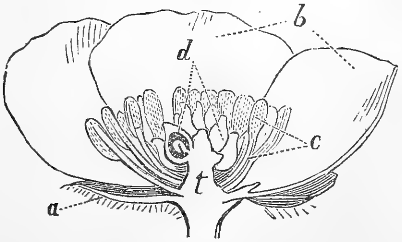


Fig. 2. Section of same flower, showing the position of the parts. *a. Sepals; b. Petals; c.* numerous *Stamens* attached to the elongated receptacle or torus (*t*), and situated below *d.*, the *carpels* or fruit, containing the seeds.

more girlish years, when this portion of her pleasing task of decking our earth was imposed upon her. Mayhap also, she may have breathed into the ears of her admirers of the present day, to lead off with Clematis, and thus constitute the Ranunculaceous order, the foremost of the great class of Exogens.

Of the above genus Clematis, the *C. Virginiana* and *C. Verticillaris* are the two most northern species. After leaving Canada for the North West they seldom occur, although they are to be met with south of 54,° where the soil is rich and shrubs are numerous. According to Hooker, the latter is found as far west as the Rocky Mountain, and plentifully at Cape Mendocino on the Pacific, but the C. Virginiana does not appear to pass the longitude of Red River, or Lake Winipeg.

Among the Anemones, the two, which I have seen display themselves most conspicuously in Canada, are the *Anemone Pensylvanica* (the "Aconitifolia" of Michaux,) and the *A. Virginiana.* The former keeps its ground throughout the extent of the British territory, eastward of the Rocky Mountain and even westward, though less plentifully. The latter is less extended, scarcely reaches the Mountain, and is much more rare. Coppices of aspen, alder and young birch, not far removed from river banks, are the situations selected by these Anemones. They are of strongest growth in Canada in old garden ground, which may have been allowed to run waste. That slender little Anemone, the *A. Nemorosa*, so elegant in form and delicate in flower, is common to the westward of Lake Superior, along the frontier line of the United States. Choosing rich alluvial soil, it appears with the early violets, in woods where the sun is not entirely excluded by foliage or the growth of the shady fir tribes. It is a very interesting plant, prized by those who love the lightest carmine tint upon pure white. Besides these three Anemones, so well known in Canada, two or three species of low growth, and bearing flowers of various shades of blue, are to be met with by one travelling the continent from east to west. Like the Crocuses of British gardens, they appear to gladden the eye, as soon as the ground is clear of its winter covering, striving, as it were, by their early yet modest forwardness, to satisfy the longings of the impatient naturalist. The *A. Richardsoniana*, not a very showy Anemone, is a stranger to the two provinces, but in the north it sends up its yellow cup, where its more stately sisters decline to reside. In the moss of pine barrens, it stretches along

its slender rhizoma, enjoying its soft bed and loving to associate with the Rubus Arcticus, whose habits it seems to imitate. Estranged from its relations, it chooses friends of congenial tastes. According to Torrey, it is found throughout Siberia, and possibly may have advanced like the mongrel, from west to east. I have had the plant from McKenzie River, and it has location in various parts of the Hudson's Bay territories, decreasing as it approaches Norway house or the north end of Lake Winipeg.

By the illustrious Linnæus and earlier systematists, the *Hepatica Triloba*, or Liverwort, was classed with the Anemones, to some of which it bears a strong affinity. As far as I have learnt, it is not to be had in the Hudson's Bay Territories, out of the ranges of the Rocky Mountains. In the vallies of these, it was found by Drummond, that unfortunate wandering collector, and as far north as latitude 55°. Here an interesting enquiry forces itself upon us. If this plant really do not exist in the great extent of country lying between Western Canada and the Rocky Mountains, how has it taken the mighty leap? Can it have made a circuit by the waters of the Missouri? Nature, we know, is not discrepant with herself. Will any theory of Appetencies or Okenian system of development account for these huge strides of vegetable species over numerous parallels of longitude? Is it not much easier and more rational at once to suppose, that there is an Almighty Creator and wise Distributor, exercising his unfettered power and will, in all things pertaining to man's terrestrial abode?

Coming now to the grand denominator, if not type, of the order, the genus RANUNCULUS, we have a mass of plants whose occurrence and distribution are so general and varied, that it would defy the efforts of the most accurate and extended observation to particularize or define them. Each species has more or less its own lines of extension and march and its own choice of favorite localities, so that the limits of range and abundance or scarcity in growth, cannot be easily or shortly specified. Such minute detail also would in a paper like this be tiresome and devoid of interest. Yet, something must be said on the subject.—The *R. Cymbularium* and *R. Reptans*, with undivided leaves, and the *R. Affinis*. *R. Ovalis*, *R. Abortivus* and *R. Sceleratus*, with foliage more or less cut and lobed, are the common species about Lake Winipeg, and probably throughout the Hudson's Bay country. The *R. Aquatilis*, or River Crowfoot, so remarkable for its nu-

merous white little flowers on the surface of pools and of the still waters of very sluggish rivers, is as often met with by the voyageur in the wilds, as by the sportsman in Canada, who in his search for wild-fowl frequenting water, will stumble upon it often. It may be considered the lily of the frogs; for where it is, frogs delight to dwell. Its range is most extensive east of the Rocky Mountains, stretching, as it does, from the Arctic circle to South Carolina. It is confined on the east and west only by the Atlantic and Pacific oceans, although less abundant on the western side of the continent. Of that strong and rough species, the *R. Hispidus*, I have specimens from McKenzie River. It is found elsewhere throughout Rupert's Land.

The very general and extensive distribution of some of the most acrid species of this genus has no doubt, like everything else in the constitution of nature, its own wise purposes. The natives are aware of the properties of these plants, and the Doctors or Medicine Men make use of the *R. Aquatilis* and *R. Sceleratus* and others in their practice, but probably without any precise idea as to their peculiar action in the cure of the patient, their knowledge being strictly experimental. It must be admitted, however, that considerable skill is shown by them at times in the healing of wounds and cure of sores.

The *Caltha Palustris*, or Marsh Marigold, as it is called in some parts of England, may be said to cross the Continent, but I am not aware of its having a high northern latitude. 56° may possibly be the line which it does not pass, that is to say, on the eastern side of the Continent.

In certain parts of Lower Canada, the *Coptis Trifolia*, or Golden Thread, is very plentiful; but I have not observed it to be so abundant further in the interior, certainly not about Lake Winipeg. According to Sir John Richardson, it runs north to the parallel of 58°, and Torrey has it from the bogs of Greenland and Labrador. The same able Botanist quotes North West America, (Sitcha, Unalashka,) also as its habitats, from which we see at a glance the wide range of this pleasing little plant, with its small staminate looking petals, and its bright yellow, creeping and useful roots. Two other species, not existing in Canada or Hudson's Bay Territory, are found to the westward,—one, the discovery of the celebrated Menzies on the north west coast, named by Salisbury *C. Asplenifolia*; the other, of late introduction to the knowledge of botanists, the *Coptis Occidentalis* of

Nuttall, discovered, I believe, by Mr. Wyeth, in the Rocky Mountains. Science is indebted to this gentleman for several additions made to the herbarea of North American plants, although it was mercantile enterprise and views of trade alone that led him to cross the continent to the Columbia.

Of the AQUILEGIAS or Columbines, one species of which is so highly graceful and ornamental to Canada, I have not been able to collect more than two kinds, viz.: the *Aquilegia Canadensis* of known celebrity, and the *A. Brevistyla* of Hooker. By this botanist, the former is said to be very abundant at the mouth of the Columbia or Oregon River, and also in the Rocky Mountains between latitudes 52° and 55°. I am not aware of its existence to the northward of 56°, and would therefore say it preferred a domicile within a zone, bounded by a line of 40° on the south, and 56° on the north, making choice of dry situations and warm exposures, where the soil is suitable. It may be noticed here, that Torrey does not seem to admit the Columbia or Pacific Coast as a locality for this plant, which renders it probable that the *Aquilegia formosa* of Fischer, which resembles closely the *A. Canadensis*, was the species which Hooker took for a variety of the other.

In all my walks I have never yet had the pleasure of meeting with the *A. Brevistyla*, but it has been sent to me from Mackenzie River. I conclude that it is very rare to the southward of Lake Winipeg, although, according to some, it is a native of Western Canada.

Following naturally the Aquilegias, come the Larkspurs, or genus DELPHINIUM of Linnæus. Several species, not known in Canada or on British Territory, grow in the southern and western States of the Union, being natives there, and others also in California and the Oregon. The *Delphinium Exaltatum*, found in Canada, attains to a high latitude, as it passes the barrier or ridge of high land that separates the waters running eastwards into Hudson's Bay from those that fall by another course into the Arctic ocean. In these northern latitudes, it is probably confined to the limestone strata and the warmest exposures. I have dried specimens of some size from friends in the north, who gathered them on the banks of Clear Water River. I must own, I have not met with it myself between Lake Winipeg and Canada. To me, therefore, this fine plant, like the Hepatica, appears to have taken an immense leap of nearly 2,000 miles. If there be connecting links along this great distance, where the *D. exaltatum*

shews itself, the chain must run to the southward of Lake Superior, crossing westward to Red River, and from that by the west side of Lake Winipeg and the northern tributaries of the Saskatchewan to the waters of Peace River.

The two species of ACTÆA, or Baneberry, common enough in Canada and the northern States, and so conspicuous in autumn by their cylindrical bunches of red and white berries, occur sometimes in woods where there is depth and richness of soil; but while the *A. Rubra*, according to Hooker, travels as far north as 60°, the *A. Alba*, I imagine, does not pass the latitude of 53° or 54°. This seems surprising, the "Alba" being so near akin to the "Rubra" in every respect, excepting the color of the fruit and the thickness of the pedicels, that by Pursh they were taken as varieties merely of the same species.

THALICTRUM closes the number of the genera of the order, which have come under my observation within the temperate climate of British North America. The *T. Dioicum*, called in the United States "Early Meadow Rue," although possessing no affinities with Rutaceæ, and little in common with the Rue plant, except a sort of resemblance in the leaf, is a hardy subject of our northern climes. Sir John Richardson states it to be in latitude 67°, on the grassy banks of the McKenzie, and American botanists give South Carolina as its southern bounds. It spans therefore nearly the whole breadth of the Temperate Zone. It enjoys a very short summer in its close look at the Arctic circle, and on the other hand can have very little winter, as a neighbour to the Magnolias and Agaves, and such tropical plants as stray a few degrees north, out of the torrid zone. Like the *Thalictrum Cornuti*, it springs up among the rich herbage along the banks of rivers, and seems to prefer limestone districts. In Lower Canada I have found the *T. Cornuti* frequently; and it is, I dare say, the most common species in that Province, and countries of the same parallel of latitude westward to the Pacific. It comes up north as far as 56°. If Hooker be correct, it takes a bound across the prairies of Central America, clears the Rocky Mountains, and seats itself again in the woods of the Columbia and the western portion of our continent.

Before finishing this paper, I may mention that of the 39 full genera of the order, noted by Lindley, Torrey has 21, as existing natives of North America, some of these genera displaying many species, such as the Ranunculus, Clematis, Anemone, and Del-

phinium, while others can sport only one. Among the latter is Hydrastis, taking its specific name from Canada. It is more abundant, however, to the southward, and it may be remarked of this plant, that it is not found to the westward of the Mississipi, nor any where, I believe, within the British Territories beyond Canada. It seems to have a liking to the Alleghany range and the streams running from it. It is found generally on the slopes of hills, where the growth of timber can afford it shade, and the soil sufficient moisture.

One or two species of Pœonia have been found westward of the Rocky Mountains, but not as yet to the eastward. Indeed they appear to have been dainty in adopting situations for their residence. The *Pœonia Brownii*, called after him who was styled by Humboldt the prince of botanists, has been found in the Blue Mountains and their vicinity, (from which locality I procured seeds for the unfortunate Douglas), and on the great volcanic range from which start up the snowy peaks of Rainier, St. Helens—Mts. Hood and Jefferson. Its discoverer Douglas has enriched British gardens with this and numerous other beautiful North West American and Californian plants. The other species which we owe to Mr. Nuttall appears only to be obtained from the neighbourhood of Ste. Barbara, Upper California, and has been named *P. Californica.*

The Genera which I have not touched upon, are—Myosurus, Cyrtoryncha, Trollius, Enemion, Aconitum, Cimicifuga, Trautvetteria, and Zanthorhiza, as they have not come under my observation. They have few species in North America. Torrey describes 4 in Aconitum, 4 in Cimicifuga, 2 in Trautvetteria, and 1 in each of the others. With the exception of *Cimicifuga racemosa*, he places none in Canada. They are to be found in the central and southern States of the Union, California, and the Oregon.

We thus see a pleasing variety in all that concerns this order of herbaceous plants. In the inflorescence as well as the fruit, the differences are very remarkable. The genera Clematis, Anemone, Thalictrum, and Hydrastis, cannot be said to have petals, although the sepals are coloured or petaloid; the Ranunculus and Pœonia have from 5 to 10. While the 5 petals of the Aquilegia have spurs at their base, the Delphinium has the upper sepal spurred, and in Aconitum it takes the form of a helmet, or is vaulted. In the fruit, we find also a sportiveness with all that

might be considered regular. The Ranunculus has its Torus with the dry, hard implanted Akenia, the Hydrastis its juicy berry, while the Aquilegia is contented with nothing fewer than five erect follicles. Seeing so great diversity of form pervading the genera of this order in the most important parts of their structure, the flower and fruit, in all which however there is a connecting law, traceable by the philosophical and scientific botanist, let us not be surprised at perceiving, that Ranunculaceæ love change and variety likewise in their habits, their extension, residence, quantitative growth, numerous or rare distribution, &c. Although the ablest minds will never be able to account for these matters, these apparent whimsies and caprices of Flora, yet we may be sure that a regulating law directs them also, and we may be well content that it is so, since the study of such intricacies and diversified subjects in nature serves so remarkably to the employment of man's best faculties, and the mental powers, while the contemplations arising out of these studies are calculated to impress us with so much delight. The Creator and Distributor of the whole has thus magnified and multiplied our sources of pleasure, and therefore to Him are all the praise and honor due.

ARTICLE III.—*On the iron ores of Canada and the cost at which they may be worked.*

The iron ores of this Province are chiefly confined to the Laurentian system of rocks, in which they occur in such prodigious quantities that this may be styled pre-eminently the iron formation. The origin of those ores we know not. It is only certain that during the period when the Laurentian rocks were in process of being formed, iron was abundantly elaborated, while in the age of the Huronian deposits copper was principally produced and iron not at all in any great quantity. The following section is intended to give an idea of the order in which these formations repose upon each other.

Fig. 1. *An ideal section from the iron mine in Hull across the valleys of the Ottawa and St. Lawrence to the iron mines in the Adirondack mountains in the State of New York.*

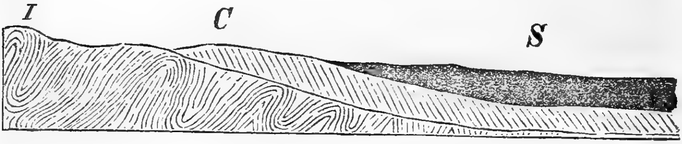
Fig. 1.

H.—*Iron mine in Hull.*
A.—*Ditto Adirondack.*
O.—*Channel of the Ottawa.*
L.—*Ditto of the St. Lawrence.*

In the above section, the dark mass in which the beds of the two rivers are excavated is Silurian, consisting of sandstones, limestones and shales full of organic remains. The base of the figure represents the Laurentian formation composed of various kinds of hard rocks, such as gneiss (commonly called granite in this country) and white crystalline limestone. From the hills on the north shore of the Ottawa where they hold iron in great masses, these rocks dip under the Silurian sandstones and limestones, and come out again to the surface in the State of New York at the point A, where they also contain many large beds of valuable ore. It is evident that the valley between these hills H and A was, during the Silurian age, occupied by the ocean, because the greater portion of the deposit represented by the dark part of the figure is full of petrified marine animals. The floor of that ocean was formed of the Laurentian rocks, but when these are closely examined, they are clearly seen to have been also of aqueous origin although they do not contain fossils. They are stratified, and some of the beds have been ascertained by Sir W. E. Logan and Mr. Murray to consist of conglomerates or rocks made up in part of rounded pebbles, which no doubt had been worn by the action of water. These facts are sufficient to prove that they were formed under water, but then other circumstances show that they were not the product of the same ocean which accumulated the Silurian strata now lying upon them. In the first place, they are bent twisted, and tilted up at all angles, while the Silurian rocks are in general nearly horizontal, and lie in broad sheets across

their upturned edges ; and in the second place, in Western Canada, another formation lies between the Laurentian and Silurian. This fact is illustrated by the following figure which represents a section from the county of Renfrew westerly to Lake Huron.

Fig. 2.



I.—*Laurentian or iron formation.*
C.—*Huronian or copper formation.*
S.—*Silurian.*

The above figure gives the order in which our mineral wealth is laid up in the crust of the earth. The Laurentian contains iron in great abundance, but, only insignificant traces of copper. The Huronian is full of copper veins, but with very little iron, while the Silurian holds neither iron nor copper. Again, as the Huronian lies between the Silurian and the Laurentian, the Silurian does not belong to the age immediately succeeding the period during which the latter was deposited ; and further, as the Huronian rocks rest upon the upturned edges of the Laurentian and the Silurian upon the upturned edges of the Huronian, great intervals of time must have elapsed between the period of any two of the three. The Laurentian epoch was the age of iron, and long after its termination came the Huronian epoch when copper was produced. In the valley of the Ottawa below Lake Temiscamangue Huronian rocks were never deposited, consequently as we find the Silurian in this part of the country where the line of contact can be seen always resting upon the Laurentian rocks, our chances therefore of finding great quantities of copper in this part of the country are exceedingly small.

The above remarks are intended to give an idea of the geological position of our iron ores, and we shall now proceed to the discussion of their extent and cost of working. It must be borne in mind that the Laurentian rocks constitute the surface of Canada throughout an area of 150,000 square miles, that a vast proportion even is still a wilderness, and that therefore the beds of ore as yet discovered in all probability constitute but a small

part of the whole mineral wealth of this important formation. The best known mines are the following :

1st. *The Hull mine*, situated five miles from the city of Ottawa, 100 feet in thickness, and containing according to the analyses of Mr. Hunt, Chemist to the geological survey 69.65 per cent, or in round numbers 70 per cent of pure iron. When this bed of ore was supposed to be only 20 feet in thickness, Sir W. E. Logan estimated that it would yield for every fathom forward and downward from fifty to sixty tons of pure metal. Report of 1845-6, page 76. But this bed is now ascertained to be 100 feet, (more of it being at present exposed by the process of mining) and consequently the yield will be five times as great, or from 250 to 300 tons per fathom. The distance to which it may be worked cannot be ascertained. As a general thing, veins of ore have never been traced to their termination, no doubt this bed underlies the country for many miles in one continuous sheet. It is not a vein filling up a perpendicular fissure in the earth's crust but a bed lying between the strata of the formation. Where it is exposed, it forms a dome and dips aways in all direction. How for it extends cannot be ascertained, but granting that 500 fathoms is its limit each way, then, it would contain 250,000,000 of tons of pure iron.

2nd. *The Crosby Mine.*—This bed is said to be nearly 200 feet thick, and should its yield be as great in proportion as that of the Hull mine, it would contain in a superficial area of 1,000 fathoms, 500,000,000 of tons of pure iron. This enormous bulk of metal can scarcely be comprehended. Were the whole iron mining force of Great Britain and the United States at work for one hundred years upon such a deposit, they would not, at their present rate of production, exhaust it.

3rd. *South Sherbrooke.*—There is in this Township a bed 60 feet in thickness, and its probable contents, according to the above estimates, are 100,000,000 of tons of pure iron.

4th. *McNab.*—This mine consists of the specular oxyde of iron. The bed is 25 feet thick, and contains perhaps 50,000,000 of tons to the 1,000 fathoms square. It is situated about one mile from the village of Arnprior, 30 miles from the City of Ottawa, and in the midst of an abundance of water-power.

5th. The beds from which the *Marmora Iron Works* are supplied, may be estimated as containing 100,000,000 of tons.

We have, therefore, in the above five beds, in round numbers, 1,000,000,000 of tons—a quantity sufficient to yield 1,000 tons

of iron a day for 3,000 years, could furnaces be erected and kept in operation capable of smelting that quantity. And as the deposits above mentioned are only a part of the known iron wealth of the Province, and, in all probability, but a small proportion of that which is at present unknown, but must be brought to light as the Laurentian region becomes settled, it is clear that we may safely consider the stores of this metal inexhaustible.

It must be recollected that these ores are generally of a very superior quality, that they make the best kinds of iron, and that some of them are so situated that, for a great length of time, they can be quarried in the open air. In Europe, veins of iron, two or three feet in thickness, are followed deep down into the earth; but in this country, a superior material for smelting can be turned out in huge blocks upon the surface, with as little labour as is required to take building stone from an ordinary quarry.

When the enormous quantity of our iron ores is taken into consideration, it cannot but be seen, that to reclaim them is most important for the advancement of the national wealth of the country. What boots it to us that nature has literally floored one half of the Province with mineral wealth, if we do not reach forth our hands, and convert it into a material having commercial value?

The principal difficulty which appears to stand in the way of the manufacture of iron in this country, is the want of coal. There can now be but little doubt but that the coal formation does not occur in Canada; but then we have wood in abundance, and the best of iron can be made with charcoal. It is supposed, however, that the manufacture of iron by charcoal would be an unprofitable undertaking. But in the United States great quantities of the metal are produced from the same ores we have in Canada, with no other fuel, and it appears to us, with a profitable return upon the capital invested. The following quotation from an excellent Lecture, delivered before the Mechanics Institute of Toronto lately by Professor Hind, of Trinity College, shows the extent of the manufacture both in Britain and the United States:

"No one disputes that the iron industry is of immense importance, and supplies the means of living, directly and indirectly, to many millions of our fellow men,—in 1855, Great Britain alone manufacturing 3,585,906 tons of iron, valued at £23,000,000 currency. This vast production employed 238,000 men, representing a population of 1,190,000 persons, or nearly as many people as

there are now in Upper Canada. 2120 steam-engines, of an aggregate power, represented by 242,000 horses, were also instrumental in this production of iron in Great Britain.

"The growth of the iron trade and manufacture of the United States, during the last forty years, has been very great. In 1816, there were 153 furnaces, producing 54,000 tons of pig iron; in 1855, there were 540 blast furnaces, averaging 900 tons each annually, yielding 486,000 tons; and 950 bloomeries, forges, rolling and splitting mills, yielding of bar hoops, &c., 291,000 tons, and of blooms, castings, machinery, and stove plates, 151,500 tons; making, that year, an aggregate of 929,100 tons, at the value of $33,940,500. In 1853, the rapid increase in this class of manufacture was such as to yield more than a million tons of pig iron.

"The United States producing in 1855, more than 1,000,000 tons, shows that the iron industry has already become very extensive in the neighbouring Union. How far the want of coal as fuel for smelting may interfere with future Canadian production, remains to be tested. There can be little doubt that when the railway is constructed from Peterborough to the Marmora iron region, the demand for coal so universally springing up in the basin of Lake Ontario, will enable it soon to be laid down at the mines at as cheap a rate as it is now furnished at Lake Ports."

Now, of the iron made in the United States, no doubt a large proportion is smelted with mineral coal, but a great deal is also made with charcoal, especially in the State of New York, where the Laurentian formation appears in the region near Lake Champlain and the Adirondack mountains. The following particulars relating to these works, have been gleaned from a series of articles, which appeared in the *Railroad Journal* for 1849. Speaking of the furnaces in Clinton county, he says: "The works are generally small, scattered over the country in the neighbourhood of the various mines. The principal portion of the inhabitants are directly dependant upon it, the only employment not closely connected with it being lumbering, for which the fine forests of this region afford abundant materials. In the long winters, when nothing can be done in farming, the farmers find a busy occupation for themselves and their teams, in drawing in the supplies of charcoal, wood, and of ore. At this time, the roads covered with deep snow, are in the best order for hauling heavy loads, and new ones are easily opened through the woods and over the roughest ground by merely clearing out the brush. The works, in general,

involving little capital, are put up by men of moderate means, and in remote places; while the iron made in them, being a refined article, can pay a rate of transportation to market, that would be ruinous to those making the cheaper pig metal." It will be seen by the above, that these furnaces in the forest are principally employed in the manufacture of bar iron instead of pig iron. The price of the article from these localities is from £17 10s. to £25 per ton in New York.

At one of the principal furnaces, called the Siscoe, the cost of making a ton of pig iron is thus stated by the writer of the articles in question:

Ores	$4 12
Charcoal	8 40
Flux and labour	2 70
Repairs, Interest, &c.,	3 00
	$18 22

Thus, for about £4 10s., a ton of pig iron, worth £8, can be made, yielding a profit of £3 10s. The cost of this furnace was $54,903 78. The wood costs $2 per cord. The manufacturers purchase the wood, and make the charcoal in kilns prepared for the purpose. One cord of wood makes 56 bushels of charcoal; and 160 bushels of charcoal make 1 ton of iron.

At the East Moriah furnace, the cost of making a ton of pig iron is	$19 53
At the Crown Point furnace	$17 58
At the Mount Hope furnace	$21 00
At the Brasher furnace	$22 50
At the Constantia	$17 50
At the Clinton	$12 81

In all these places, wood costs about $2 per cord, a price which would be very acceptable to our farmers in the vicinity of our mines, where they cannot sell the wood at all, but are obliged to burn it to clear the land. The absence of mineral coal is actually no objection to the manufacture of iron in Canada. What we want, is information how to construct the proper works. It must be recollected, that it was long before the Americans found out how to make their furnaces pay; and there can be no doubt that, with the benefit of their experience, works could be erected in Canada that would be profitable. We can see no reason to the

contrary. Wood is cheaper, our ores quite as abundant, and the demand for iron as great. With the same advantages then, why cannot we do as well as the Americans?

Two or three years since, the bed of iron ore in Hull was sold to a Company, who quarry the material, and carry it all the way to Pittsburg, in the State of Pennsylvania, where they convert it into iron. If it pay to manufacture this ore, after a transportation of several hundred miles, surely it might be worked on the spot. At the City of Ottawa, you may see, at the same wharf, a barge laden with our ore on its way to the United States, and along side of it, another barge load of sheets and bars, imported from Europe. This looks like carrying coals to Newcastle.

In the United States, they have a method of making malleable iron from the ores by one fusion. This is not a new process, because we saw it in operation thirteen years ago, at a small forge in the County of St. Lawrence. The operation is thus described in the excellent report of Messrs. Foster & Whitney on the Geology of the Lake Superior region.

"The ore is introduced into the top of the forge, in alternating charges with charcoal, in a state of great mechanical subdivision, resembling coarse sand, having been previously calcined, stamped and washed, if it contain much earthy matter. The supply of fuel is maintained in the first stages of the process so as to keep the space full, and prevent the ore from collecting together. Water is occasionally sprinkled over the surface, which prevents the fine siftings from being blown away, and gives increased fusibility to the scoriæ. The ore falls down, and the melted iron collects in a mass at the bottom of the hearth, while the thin slags run off by an upper overflow The mass is removed about every hour, in a pasty condition, by means of a powerful pair of tongs—working by an iron wheel on a railway suspended from the beams above—which seizes it firmly, and conveys it to an anvil, where an iron lever, called a "squeezer," working up and down, kneads the particles of iron together, forcing out the semifluid cinders, and fashioning the loup for the rollers, to which it is transferred.

"The substitution of drawing cylinders in the place of triphammers, has greatly facilitated the manufacture of iron. It accomplishes in a few minutes the condensation of the particles. and the distribution of the fibres, which formerly was attained only after repeated heats and hammerings.

"In cylinder drawing one workman holds the loup in a pair of tongs, and passes it into the first of the grooves; another workman, on the other side, receives it, and passes it back to the first, who passes it into a second and smaller set, and so on, until it is reduced to a bar, three or four inches broad, and two in thickness. This is then cut by powerful shears into short lengths, called "blooms," which are afterwards subjected to a refining process.

"So great is the dexterity displayed in these various processes, and so admirable the adaptation of the machinery, that the rude ball, as it comes from the forge, is converted into mill bar iron before it has had time to cool. The whole operation is accomplished in a little more than a minute.

"The bars are next subjected to the refining process, which consists in heating them in the oven above described, and bringing to a welding heat, which is accomplished in the course of one-half or three-quarters of an hour. Where great tenacity is required, they are re-heated and rolled. From the oven they are passed to the extension rollers, where they are fashioned into the required form, whether round, square, oval, or rectangular."*

The iron made in this way, will resist a pressure of over 70,000 lbs. to the square inch.

The above facts were collected from various sources, with the view of showing that iron can be manufactured in this country, although we are destitute of mineral coal. It would be well for the Province were this branch of industry introduced and encouraged to the utmost. The vast forests in the neighbourhood of the mines, are fast disappearing before the axe of the sturdy settler, and the only fuel we have to convert our rich stores of metal into the elements of national wealth, is being thus destroyed, without being made serviceable to man to the full amount of its capabilities.

E. B.

ARTICLE IV.—*On Serpentine, and some of its uses.*

This mineral species was known to antiquity, and received from the Greeks the name of *ophitès*, in allusion to its variegated greenish colors and peculiar lustre, which were supposed to

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* *Foster & Whitney's Report on the Geology of the Lake Superior Region. Page* 79.

resemble those of the skin of a serpent (*ophis*). It is, however, probable that some of the early writers confounded under the same name with the true serpentines the harder green porphyries, which are very distinct. Linnæus, who regarded serpentine as a species of talc, described it under the name of *talcum serpentinum*, and the name of serpentine, synonymous with the Greek *ophitès*, and corresponding to the *serpentino* of the Italians, is now universally employed.

Serpentine is a soft mineral, easily scratched with the point of a knife, and gives a white powder somewhat unctuous to the touch, a property which it has in common with talc and several other minerals. Its colors are generally some shade of green, varying from oil or leek green to olive or blackish green; they are seldom bright; yellow and red serpentines are sometimes met with; the colour of the latter is due to mechanically intermixed red oxyd of iron. The finer varieties are very often translucent, constituting what is sometimes called *noble serpentine*, but more frequently the mineral is opaque, or only translucent in thin fragments. Serpentine is generally massive and without any visible structure; it is tough and breaks with a conchoidal fracture. Occasionally, however, it is met with foliated or fibrous, forming splintery masses like wood, the fibres being brittle and elastic; this variety has been named *picrolite.* The fibres sometimes become exceedingly fine, and are thin, soft and flexible, with a silky lustre, constituting a variety of asbestus, differing chemically however from the true asbestus, which is a variety of hornblende. This asbestiform serpentine has been called *chrysotile.*

The lustre of the massive varieties of serpentine is feeble, and somewhat waxy or resinous; they are capable of receiving a fine polish. Serpentine is comparatively tender and easily wrought when first taken from the quarry and yet moist, but becomes hardened when exposed to the air. When moistened by breathing upon or otherwise, serpentine gives a peculiar odour, like that of clay; hence called the argillaceous odour. The specific gravity of serpentine is from 2.4 to 2.6, water being 1.0.

As to its chemical composition, serpentine is essentially a silicate of magnesia combined with water; when pure it should contain: silica 43.60, magnesia 43.40, water 13.00=100.00; but a portion of protoxyd of iron, amounting sometimes to 7 per cent., generally replaces a part of the magnesia, and minute quantities of oxyd of

nickel, chrome and alumina, are very often present. When heated to redness, serpentine loses all its water, and turns reddish from a change in the oxydation of the iron ; it also becomes much harder. When heated in powder with strong sulphuric acid, it is completely decomposed ; the silica separates as a white powder, and sulphates of magnesia and iron are formed.

Besides employing it as an ornamental stone, the ancients attributed great medicinal and magical powers to serpentine. It was prescribed with wine for calculus, recommended as a certain cure for the bites of serpents, and was regarded as a talisman against small-pox, poisoning, lethargy and madness. It was also, as an old writer informs us, used for mortars, as "from its natural benignity, it seemed peculiarly fitted for the pounding of medicines." Boetius de Boot assures us that serpentine has such a repulsion for poisons of all kinds, that so soon as a poisoned liquid is poured into a vase of the mineral it begins to foam, and is expelled from it. And another old author, Laet, tells us that he had received from Crusius a specimen, upon which was written, "A fragment of the cup of Edward IV., King of England, formed of the stone called ophites, useful against poison; the gift of H. Morgan, 1581." But all these virtues are now forgotten, and serpentine no longer finds a place in the modern materia medica, nor is there any good reason to believe in its medicinal powers. Some calcareous serpentines effervesce powerfully with an acid liquid, and such may have given origin to the statement of de Boot.

Serpentine is found in many parts of the world; it forms mountains in the Alps, is abundant in the Apennines, in many parts of Germany, in Cornwall, forming the Lizard Point, and in Scotland, particularly at Portsoy in Banffshire. It is a very abundant mineral in Canada. The limestones of the old Laurentian rocks very often contain it in small soft, greenish or yellowish grains, disseminated through the rock. The green and white serpentine marble of Grenville is an example, and Dr. Wilson has found serpentine in this formation in the township of Burgess, in large masses, which have often a reddish colour. Polished slabs of this serpentine may be seen in the Museum of the Geological Survey.

The most important deposites of serpentine in Canada, however, occur in the hills of the Green Mountain range. Sir William Logan has traced a continuous formation of serpentine from the line of Vermont to beyond the Chaudière river on the north-

east. In this region the serpentine is no longer a subordinate mineral as in the limestone beds of the Laurentian system, but forms great rock masses which are interstratified with the slates and quartz rocks of the country. It often rises into hills, and sometimes covers areas of many miles, generally covered with a growth of pines and firs. The same range of serpentines has been followed southward through New England, and along the Alleghany mountains, of which the Green Mountains are but the north-eastern extremity.

This serpentine rock is somewhat variable in its characters. Its weathered surface is either whitish or of a rusty red; it is very tough, and when broken, exhibits the usual colours of serpentine, generally however the darker tints. Sometimes it is foliated, and then is for the most part pale green; it is often intersected by veins of picrolite or by thin seams of chrysotile, the fibres being perpendicular to the sides of the seams. Sometimes the rock exhibits the character of a conglomerate, consisting of rounded masses of serpentine of various sizes, cemented by a paste which is a dolomite or carbonate of lime and magnesia with a little carbonate of iron; at other times, we meet with a fine grained and intimate mixture of serpentine with dolomite, and the powdered mass then effervesces with nitric acid, which expels the carbonic acid from the dolomite; in other cases, pure carbonate of lime is intermingled with the serpentine, and this mixture may be distinguished by effervescing with acetic acid. Carbonate of magnesia, which also occurs in beds near the serpentine, is sometimes intermingled with it; but in the greater number of cases, the rock is nearly pure serpentine. Chromic iron, which is the only source of the oxyd of chrome and the chromates of potash, lead, and zinc, so much used in dyeing and painting, is chiefly found in serpentines, and is almost always present in those of Eastern Canada, generally in small grains, but occasionally in beds of considerable size, as in Bolton and Ham.

The economical uses of serpentine are important. From the beauty and variety of its colour and the ease with which it is wrought, it is much employed as an ornamental stone. Thus, at Portsoy in Scotland, Baireuth in Franconia, and Zoblitz in Saxony, it is extensively manufactured into vases, ornaments, and articles of furniture. At Zoblitz, it is said, that some hundreds of persons are employed in quarrying, cutting, turning, and polishing the serpentines of that vicinity, which are sent all over the world.

In Limoges, in France, quarries of serpentine have within a few years been re-opened, which were explored by the Romans, who held this stone in great esteem. Near Grenada, in Spain, also there are quarries of serpentine, which form the ornament of the palaces and churches of Madrid. The famous *vert antique* marble is no other than a serpentine intermingled with a portion of white or gray dolomite or carbonate of lime; and many other varieties of serpentine rock, not less beautiful, are known in France and Italy, as marbles *vert de mer*, *vert d'Egypte*, *&c.* The serpentines of the Vosges, in France, are very extensively wrought and employed for tables and chimney pieces, and for the decoration of churches and palaces. There are extensive mills at Epinal (Vosges) where the serpentine of Goujot, which is much esteemed, is sold when polished, for 54 francs the square metre, or about 45 shillings the square yard. The serpentine marbles of Galway and Mayo, in Ireland, are also much esteemed, and those of the New England States are beginning to attract attention. That of Roxbury, Vermont, is now coming into extensive use for furniture and interior decoration.

The serpentine rocks of Canada afford varieties which will not yield in beauty to any foreign specimens. The whole range of the Eastern townships abounds in localities which offer great diversities of hues and combinations. The colours are green of every shade, sometimes nearly black, and occasionally intermingled with white and gray. These are sometimes veined or bended, at others arranged in clouds, or in spots like a pudding stone. The only explorations as yet attempted among these beds, are those of the Geological Commission. Sir William Logan has caused trials to be made of several blocks taken from different exposures of serpentine in Brompton and Oxford, and not one of these, when cut and polished, but has afforded a beautiful variety of marble.* These specimens may be seen at the Geological Museum. It is greatly to be desired that native industry should be turned to the working of our marbles, in a region where water-power is abundant, and where, in addition to these beautiful serpentines, there is to be found a variety of other marbles rivalling

* The name of marble is strictly applied only to such stones as are composed wholly or in part of carbonate of lime; but as the marbles which are mixed with serpentine pass by insensible degrees into pure serpentine, it is not easy to distinguish between the latter and the serpentine marbles, properly so called.

those of any other country. The demand for such materials among us is already considerable, and will rapidly increase with wealth and taste. May we not hope to see the new cathedrals which are soon to adorn our city, decorated with Canadian marbles?

There is another economical application of serpentine which has now become of some importance. That of Newburyport, in Massachusetts, is ground to powder, and by a peculiar process impregnated with different vegetable and mineral colors, forming thus cheap and valuable paints, which are extensively used in the United States. We are informed, that the serpentine is partially decomposed by sulphuric acid, and that the colours seem to unite with the liberated silica, which plays a part analagous to that of alumina and oxyd of tin in the lakes.

In France, serpentine is also turned to account as a source of magnesia and magnesian salts. We have already seen that sulphuric acid decomposes serpentine with the formation of sulphate of magnesia. As a preliminary operation, the mineral is calcined at a strong red heat for forty-eight hours in a reverberatory furnace, which holds about two and a half tons. This calcination has for its object to render the iron almost insoluble. The calcined serpentine is then ground to powder, and mixed with a quantity of sulphuric acid, not quite sufficient to combine with all the magnesia. The mass becomes hot, and is converted into a paste of sulphate of magnesia, which is leached in large vats, as in the preparation of potash; the silica and oxyd of iron remain behind. A little milk of lime is added to the liquid to get rid of a small portion of iron and some other impurities in the solution, which, when then boiled down and crystallized, yields pure sulphate of magnesia—the *Epsom salt* of the apothecaries. There is an establishment of this kind at Ramiremont, in the Vosges, which has been in operation for nearly twenty years, and produces annually 80,000 or 90,000 pounds of sulphate of magnesia, which is sold at about eighteen shillings the hundred pounds, which is said to be only one-third the price of that imported.

Serpentine contains on an average 40 per cent. of magnesia, and crystallized sulphate of magnesia consists of 16.25, sulphuric acid 32.50, water 51.25, = 100.00, or one equivalent of magnesia 20, one of sulphuric acid 40, and seven of water 63, = 126. It will be seen then, that 100 pounds of serpentine, containing 40 of magnesia will require 80 pounds of dry sulphuric acid,

or about 100 of oil of vitriol, and will yield 246 pounds of crystallized Epsom salt. The carbonate of magnesia or *magnesia alba* of the shops is made by decomposing a solution of the sulphate with a boiling solution of carbonate of potash or soda. The carbonate of magnesia separates as a white powder, which is washed with water, pressed into cubes and dried. It contains about 40 per cent. of magnesia combined with variable proportions of carbonic acid and water. These are dried off, when the *magnesia alba* is heated to redness, and caustic or calcined magnesia remains. Serpentine will thus yield about its own weight of the carbonate and 40 per cent. of calcined magnesia.

There are other sources of magnesia in the dolomites and magnesites of the country, but a description of these and of some of the uses of magnesia in the arts, we shall reserve for another number of the *Canadian Naturalist.*

T. S. H.

ARTICLE V.—*General Remarks on the Study of Nature, with special reference to Botany.*

It will be acknowledged by every student of nature, that much pleasure and gratification are experienced in the general contemplation of the works of Creation. However cursory his observations may be, they exercise a wholesome influence upon the mind, excite admiration within the breast and encircle the imagination with a halo of pleasurable feelings. It is within the compass of every mind, however crudely educated, to receive such general impressions, and to benefit by the display of those objects of nature which ever prove sources of recreation. A recognition of this has led to the adoption, more especially in large towns, of extensive Parks and Botanic Gardens, which, as places of general resort, tend materially to the physical and mental improvement of populous communities. It must be remembered, however, that the mere general contemplation of the works of the Creator is not all that is required of man, to whom was given *power*, to have command over "things possessing life," and *intelligence*, to study with advantage to himself the numerous and varied objects placed before him. Nor must we be satisfied with a mere cursory glance of the

eye or a temporary excitation of the mind, and take cognizance of nothing but what is excited by striking contrast or the sudden stimulus of grand and sublime scenes. If the mind be not educated to receive the delicate impressions of nature, it has no hold, and only remembers enough to shed a ray of delight upon the imagination. In order to realize truly her beauties and harmony, we must ensure our acquaintance with her objects in detail, with the laws that govern them and the phenomena they exhibit; and what is essentially necessary to this end, is the education of the youthful mind, by which we mean, its thorough training in the exercise of minute observation, systematic comparison, and correct generalization. Nor can this be better and more easily effected than through the study of one or more of the Natural History Sciences themselves, for which the requirements are few and simple. An ardent desire to attain not a mere sprinkling of knowledge, but a thorough and intimate acquaintance with the characters and features of the objects of nature, the phenomena they exhibit, the relations they bear to each other, and the laws which govern them individually and collectively—this, coupled with an honest spirit of caution and a resolute determination to persevere, constitutes what might be called the elements for entering upon the study of Science. It is no severe and arduous task for the diligent student to pursue a successful course of study, and it is within the range of every one possessing ordinary capabilities. We observed that it is during the period of youth, that is, when the mind is expanding and the intelligence growing, when the buds of intellect are flowering into luxuriant forms and shapes—it is at this time that the mind should be infused with a relish and taste for scientific pursuits, and the foundation laid of that framework, which, when ultimately viewed, will faithfully represent the elements of the structure of an accomplished Naturalist. There is an elasticity of the mind in youth that makes it easily susceptible to impressions, and admits of its being moulded into tastes eminently scientific. There is a vigour and energy, too, that surmounts all the little difficulties and drawbacks incident to the study. But why thus, it may be asked, spend the powers and energies of youth, which should be directed solely to the study of those branches of education that more materially affect individual interests and welfare in after life? Why this perversion of the mind, as some call it? It would be almost unnecessary to reply to this question, were it not very frequently put forward in the form of a serious objection.

Nothing can be more erroneous than the supposition, so generally entertained, that Science is a superfluity, that its study is an idle occupation, and its knowledge of little or no value.

Apart from the more apparent advantages accruing from its acquaintance, its study possesses the intrinsic value of being the powerful instrument whereby the mind is exercised in habits of careful and accurate observation, of systematic comparisons, and of philosophical generalizations. In the study of the objects and phenomena of nature there is a continued process of mental labor and activity. Before the mind is perfectly adapted to the pursuit, we can easily analyze the elements of this mental process—for, though complicated, it is slow, and consists of successive steps. There is first brought into play the all-important element of *Observation*. It will be allowed that this should be minute, clear and correct; but in order to this, it must be exercised and reduced to methodical training. The untutored mind, whose powers of observation are not developed, is ever subject to aberrations and distortions, ignores plain facts or falsifies their nature, and is quite incapable of drawing correct deductions or abstracting generalizations. There can be in such a mind nothing more than a chaos of visionary ideas. Let nature then be the instrument by which we educate our powers of observation, and we will possess, in all its force and beauty, one of the rarest accomplishments.

This leads to the second important element in the mental process, viz. that of *Comparison*, which, in all its phases, observes system at its basis, and involves the due exercise of our reason. To compare well, requires a constant train of thought and reasoning, and in systematically exercising these latent powers of the mind, we are only preparing to reduce the knowledge we possess into tangible shape and form. This constitutes the last step in the series, and may be designated *Philosophical Generalization*. This brings our judgment into active operation, and entails the necessity of weighing evidences, in drawing deductions and forming our ideas and opinions. Having thus passed through a process of special training, and acquired systematic habits of observation, thought and judgment, what are the advantages derived therefrom? We believe many; but, above all, is their *reactionary influence* upon the character of man, by which we mean, the adaptation, to the ordinary business and duties of life, of the same habits and principles as those acquired while treading the paths of Science. It is impossible for one well trained by

system to deviate from the principles by and in which he was educated, nor is it reasonable to believe that he will omit to exercise the same method of observation and pursue the same process of reasoning in all circumstances requiring the play of these powers and qualities. It can, therefore, be readily understood how the youthful votary of Science, who has somewhat matured the powers of his mind, is well qualified to enter upon the public duties of life, to bear its strifes and battle its storms, and steadily and successfully gain that position which is beyond the reach of his less favored companions and competitors.

The observations just made, though applicable to the Natural History Sciences generally, are intended to have special reference to the study of botany. Without miscalculating the difficulties encountered, as well as the advantages gained in the study of other departments, we believe we can say of Botany, that in no science are the qualifications above enumerated more requisite for entering upon its study, or the same methods of thought and reasoning more fully exercised, or the same habits of diligence and application more securely acquired. To be a thorough botanist—one not merely versed in the nomenclature of plants, but intimately acquainted with their structure and functions, and with their natural classification and alliances—demands the most intense application and unwearied labour, even in the highest order of minds. The vegetable kingdom includes within itself such a vast multitude of objects and such a wide range of phenomena, that it is difficult, nay almost impossible, for the most ardent and persevering to attain a perfect knowledge of so extended a subject; and even though the facilities for becoming acquainted with the botany of foreign climes are many and various, it is only within the reach of the few favored, who dwell in the great centres of literature and science, and who devote both their time and their money in botanical study and research. Let it be clearly understood, however, that *Science never demands of any one more than his time can afford or his capabilities master.* What indeed would be the sensations created in the mind of the most profound of Botanists, were circumstances to require his possessing an intimate knowledge of the myriads of plants known to flourish on our globe, whose record numbers at the present day more than 100,000 species? No! Nature is never exorbitant in her demands. She speaks, and her voice proclaims her many beauties and charms, administers pleasures and happiness, and teaches lessons as various and beautiful

as can be found within the pages of any book. She invites us to fill up our leisure hours in studying these beauties, and in drawing thoughts of pleasure and delight from her pure and refreshing fountain. In preparing our minds, then, to commence the study of Botany, we do not bind ourselves to a laborious task in order to the acquirement of a complete and perfect knowledge of it. While we are following out our own special avocations in order to our advancement and welfare in life, we merely take up this study as a recreation for the mind in times of leisure and idleness. It is universally acknowledged that no branch of Natural History furnishes better opportunities of improvement and contributes more to the health of the body, while it is supplying wholesome food to the mind. It may be affirmed that it is the science pre-eminently popular—we say, *pre-eminently popular;* for where will we find another special science with so many votaries in every rank and station of life—not merely confined to the physician, but finding its way into the precincts of the noble palace and the sacred studio of the clergyman and the man of literature. Nor does it rest here; its influence ranges further, and glides stealthily but happily within the walls of that Institution, where are educated the fair and amiable of our society; nor will it ever cease here to be considered an accomplishment of the highest order.

In prosecuting the study of botanical science, we should not fall into the false idea that the naming of plants is all that is required. Although it is undoubtedly one of our leading objects as practical botanists, it should ever be borne in mind, that such knowledge is merely superficial and tends to no intellectual or practical good. Our great aim should be a thorough acquaintance with the science. We should study it in all its bearings. We should possess a knowledge of the anatomy and structure of plants, in order to prepare our minds for understanding the functions of their different parts, such as the roots, stem, leaves, and flowers, and for judging of their importance in the economy of nature. We should study also the relations they bear to each other, their specific differences and general alliances; and lastly, we should investigate their properties, in order to ascertain the special uses to which they may be applied in the economy of man. Having done this, it remains within our choice in what way we are to follow up our knowledge *practically*,—whether, as agriculturists, to contribute to the improvement of land in districts or countries; or as horticulturists, to beautify our private residences

with gardens, orchards, and nurseries or, what may occur now and again, to rear up a public Botanic Garden; or, should the inclinations of the botanist tend to the scientific pursuit of the subject, nothing can prove a greater source of pleasure than the forming of an *Herbarium*, or repository of plants, either of the district in which he lives or the country or continent. In order to this, he allots a few spare hours occasionally to the field. He is now seen perambulating the valley or the plain, picking here and there a plant of ordinary form and appearance; a little beyond, he gathers of the sweet and lovely flowers of the little stream or the winding river. At another time, he winds his way along its shaded banks or the rocky sides of a distant hill, adding plentifully to his stock of plants rich in gay colours, as well as shrubs of verdant green, which contrast strongly with the slender grasses, carices and ferns of the swamp beneath; while a third excursion will find him upon the ridges and summit of some lofty mountain, adorned with alpine plants of great variety, and remarkable for the fineness and softness of their texture and the rich beauty of their gay colours, and enhanced greatly by their modesty of size. These rambles, whether on the wide plain or through the extensive forest—whether along the winding river or upon the mountain top, each and all afford endless sources of pleasure and gratification. While they contribute to the health and strength of the body, they exhilirate the mind and impart to it tone and vigour. Not the least of their advantages are the wholesome impressions made upon the mind, as well as the many associations hereafter connected with such rambles. He who has united himself with his companions and formed a botanical party, and with whom he has oft visited nature's spots of beauty and gathered of its treasures, he alone it is, who can know the feelings of delight that spring within the breast, "feelings," says Dr. Balfour, "by no means of an evanescent nature, but lasting during life, and at once recalled by the sight of the specimens which were collected." An occasional glance at an herbarium will call forth many a pleasing recollection and bring to mind many a circumstance otherwise forgotten. One little alpine plant will often tell a tale of adventure and call up many a delightful association of persons, places and incidents. This is not the least of its pleasures. It appears to us, that it is only after the lapse of time, and especially when far removed from the scenes of botanical study, that we can appreciate its value; for then it brings up many

reminiscences of past kindness, friendship and pleasures, and forms a happy bond of union and sympathy between friends and acquaintances of the past. Should not this, then, be a strong incentive to the study of the Science of Nature, that in the prosecution thereof, we form the acquaintance of those who are treading the same paths, and likewise establish among them friendships always delightful and ever permanent? Can it be said so of this world? Can the man who has satiated his desires with its enjoyments say, that its pleasures are sweet, or its friendships enduring? Has he not already discovered that these pleasures are vain emptiness, and these friendships but of a day? and did he look back and take a lesson from the past, he would know that those who have gone before him, have sunk within the grave to be remembered no more—to be forgotten even by those who have been the constant recipients of his kindness and favors. On the other hand, the man of Science feels himself knit with the souls and minds of his fellow-laborers, who can appreciate his talents and his tastes—whose delight is to extend to him the warm hands of fellowship in life, and after death to cherish his name in fond remembrance.

Botany has still a higher claim upon our study and attention than those already indicated. It forms no small portion of that great Volume of Nature which, when studied in the true spirit of wisdom, forms the handbook to the Volume of Inspiration. It is the echo of the voice of the Creator "of the heavens and of the earth and all that therein is." The knowledge of the one will never be found at variance with the truths of the other. Nay, the more deeply we study each—the more minutely we compare the facts and phenomena of the one with the revelations of the other, the more evident shall we see the harmony that subsists between them, and the more beautiful the light they reciprocally shed upon each other.

J. B.

ARTICLE VI.—*Notes on the Distribution of Insects, &c.,*

BY WILLIAM COUPER, TORONTO,

Cor. Mem. of Lit. & His. Soc., Quebec, & Nat. His. Soc., Montreal.

If a keen-eyed Coleopterist confine his researches to any given district or locality he may, in one summer, attain a tolerably correct knowledge of the forms existing therein; this is only

ascertained by profound attention to the natural habits of species of the numerous genera which constitute the order. Should he find the remains of a coleopteron,* he can determine whether it is local, or of rare or common occurrence; he may occasionally capture a species that had been introduced through accident, and the representative of which may be local in another district. This applies more particularly to some genera of predaceous ground beetles, or the great family of *Carabidæ*. In this country, the banks of rivers and shores of lakes are at all times preferable to any other place for collecting this family; and intermediate soils such as deep black loam, particularly where woods can be found, are also productive.

Any one who has acquired a knowledge of their instincts and habits, and of the many curious incidents connected with their distribution, would not be surprised were he to discover on the shores of our Canadian Lakes, the representatives of species that are known to occur in other quarters of the globe. Insects and plants are liable to be disseminated by the force of wind and water, and therefore subject to an extensive and wider geographical distribution than animals of the higher orders. Examples of this nature have been noticed on the island opposite Toronto, where insects that are local to the opposite side of the lake are occasionally brought thither by floating timber containing the *larvæ* or *pupæ*, from the southern and western shores. The drift wood being covered by sand, the *larvæ*, &c., go through their metamorphoses in a perfect degree—the timber thus embedded, is well adapted for the proper development of the genera *Elateridæ*, *Buprestidæ*, *Cerambycidæ*, &c. The total removal of a plant from one locality to another, has in many cases caused its insect parasite to follow, instinct having taught it to distingnish in the plant thus removed, the original and only food of its progeny. On the western side of the Rocky Mountains, a number of plants and insects are found that are of Asiatic type. Among several beetles taken by Sir John Richardson in his travels

* Up to this time, there has been but one species of *Scarites* taken in the vicinity of Toronto. A lady, whose husband is a profound entomologist, picked up a mutilated specimen on the islands opposite this City; he instantly recognized the form, and a short time afterwards communicated the fact to me. I made a search, and discovered that this species was confined within the space of half a mile; and up to this time, it has not been captured in any other locality on the north side of the lake.

through Rupert's Land, there is one in particular, the *Carabus Vietinghovii*, which Kirby says is synonymous with Dr. Fischer's figure in his Russian Entomology.

"The close and accurate observation of nature most forcibly induces that frame of mind so beautifully described by Shakespeare, in which we are disposed to find

> "Books in the running brooks,
> Sermons in stones, and good in everything."

To those who take no interest in science it would be difficult to explain the feeling with which the geologist regards a rock, a Botanist a flower, or an Entomologist an insect; it is something quite peculiar, and can only be understood and appreciated by those who have passed from ignorance to knowledge, and have felt how *immeasurably* their enjoyment of life has been heightened, as they have become better able to appreciate the wonderful works of God.

The connexion between different sciences is always very interesting, and that between Zoology, Physical Geography and Geology, is no exception to the rule. Lists of species have long been used as excellent tests of the age of deposits found in different parts of the world, and the labours of Professor Edward Forbes have made known to us that interesting evidence on the Geography of ancient times may be obtained in the same way from a careful examination of the lists of species. In his paper on the *Geological relations of the existing Fauna and Flora of the British Isles*, he shows that out of sixty-five species of testaceous molluscs which are common to the coasts of the United States and of Europe, fifty-one are known as glacial fossils, of the remaining fourteen, two are pelagic wandering mollusca, one Teredo Navalis is carried about in floating wood, two are small species living in stony ground, near high-water mark, and therefore not likely to be found fossil; three are Chitons, which fall to pieces soon after death, two are doubtful, and the other four may very probably yet be found fossil. The inference which Professor Forbes draws from these facts is, that "not a single littoral or coast, inhabiting Mollusc has found its way across the Atlantic, in either direction, since that ancient time, anterior to all human records, and probably long anterior to the appearance of man on our earth, when an Arctic sea, inhabited by a limited and uniform fauna, extended from the then western coast of Siberia into the heart of North America, and southwards in

Europe to the parallel of the Severn, and in America to near that of the Ohio............ There could not have been such a separating abyss between Northern Europe and Boreal America as now divides them ; the sea, through a great part, must have been a shallow sea, and somewhere, probably far to the north, there must have been either a connexion or such a proximity of land as would account for the transmission of a non-migratory terrestrial and a littoral marine fauna.

Mr. Wollaston says that, out of 482 species of Coleoptera occurring in the Islands of Madeira, 201 are also found in Europe. To account for this we must suppose one of two things, either that the latter number of species have been introduced by accident as by man or by winds, or some similar cause ; or else that these species have been in existence ever since the time when Madeira formed part of the great continent. The latter supposition will certainly be preferred by all who have studied the great changes which have taken place in the distribution of sea and land even in the most recent Geological period.—*Lubbock.*

In the family *Cicindelidæ*, the species taken in this vicinity evidently belong to a single genus. No species which can be classed under *Megacephala*, *Omus*, *Amblycheila*, or *Dromochorus*, have been discovered north of Lake Ontario ; of the last genus, but one species occurs north of Mexico. We have eight species of the genus *Cicindela*, but they so closely resemble each other in elytral characters, that the student encounters much difficulty in determining a true form from a variety.

With regard to our great family of *Carabidæ* those that have been collected must remain for the present untouched, until one of our museums procure a foreign collection, containing true generic forms.

Dr. LeConte of Philadelphia, has published an excellent classification of those occurring in the United States. We are indebted to this gentleman's skill and energy for the present advanced state of this branch of the Natural Sciences in America. Many species of *Dyticidæ* inhabiting our waters, are described by him in "Agassiz's Lake Superior."

Silphidæ—Five species of the genus *Necrophorus* are now known to occur north of Lake Ontario ; and of the three following genera—viz : *Necrodes*, *Oiceoptoma*, *Thanatophilus*, but one species of each, whilst of the genus *Necrophila* we have four species which are purely northern types.

Dermestidæ, Pyrrhidæ, and Histeridæ are equally represented in the north. They are of the same habits, destroying furs and other animal substances; species of the three families are frequently taken together. Importing furs, &c., from America to Europe may have been a source by which some of the American forms effected so extensive a distribution. Of Histeridæ, the representatives of four English species are now known to occur in North America.

Lamellicornia—Thirty-seven species of the following genera inhabiting the United States, have been taken in Canada: *Canthon*, 1; *Copris*, 2; *Onthophagus*, 2; *Aphodius*, 3; *Trox*, 3; *Geotrupes*, 2; * *Bolbocerus*, 1; *Lucanus*, 3; *Dorcus*, 1, probably 2; † *Platycerus*, 2; *Passalus*, 1; *Xyloryctetes*, 1; *Pelidnota*, 1; *Areoda*, 1; *Phyllophaga*, 2; *Omaloplia*, 1; *Serica*, 1; *Dichelonycha*, 1, probably 2; *Macrodactylus*, 1; ? *Valgus*, 1; *Osmoderma*, 2; *Trichius*, 2; *Cetonia*, 2.

Cearmbycidæ—The number as yet found in the United States, north of Mexico, is 270, while in France 180 has been found, and in England 64. The six following species—*Criocephalus rusticus*, *Hylatrupes bajulus*, *Phymatodes variabilis*, *Clytus Gazella*, *Callidium sanguineum* ? *Monohammus sutor* (?) *Pachyta sexmaculata* appear to be identical with European species. The North American forms of Longicorns seem to have a nearer relation to those of Europe than to those of South America; the same genera being mostly found in both regions, to which some of the northern forms are almost entirely confined, as *Oberea*, *Rhagium*, *Pachyta*, *Strangalia*, and *Leptura*. The Prionidæ are almost fully represented in the western hemisphere; the genus *Elaphidion*, *Desmocerus*, *Tetraopes*, *Dorcaschema*, and others are strictly

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* I believe this is the only species of the genus taken in Canada:—Color ferrugineous; Clypeus margined, granulate, and rounded in front with two minute tubercles between the eyes; thorax margined, densely and minutely punctured, transversly elevated in front, with a longitudinal furrow in the disc, and lateral black spot; scutellum bell-shaped, smooth, and very distinct; elytra densely punctured in rows, about 16 in each clytron; body pilose; tibiæ toothed. Length 5 lines. Not determined.

† Of this genus two North American species, are already known. Mr Ibbetson, late Assistant. Commissary General of Montreal says—that a third one has been taken by him in Canada which differs in size and color from *quercus* or *depressus*, and that probably it is new.

North American forms, while the extensive European apterous genus *Dorcadion* is perhaps entirely unknown here. Amongst the genera common to North and South America may be mentioned *Mallodon*, *Callichroma*. *Eburia*, *Amniscus*, *Onciderus*, *Hippopsis*, *Amphionycha* and *Distenia*—HALDEMAN.

. The genera collected in Western Canada are *Orthosoma*, *Tragosoma*, *Criocephalus*, *Arhopalus*, *Callidium*, *Phymatodes*, *Physocnemum*, *Clytus*, *Euderces*, *Helliomanes*, *Graphisurus*, *Monohammus*, *Plectrodera*, *Tetraopes Compsidea*, *Saperda*, *Oberea*, *Desmocerus*, *Rhagium*, *Toxotus*, *Evodinus*, *Acmaeops*, *Strangalia*, *Leptura*, *Trigonarthris*.

Two of the species mentioned by Haldeman, viz.:—*C. sanguineum*, and *M. sutor* are European species, but there is a doubt regarding their occurrence in America. *M. resutor* Kirb. and *M. scutellum* Say, are synonymous. Kirby describes *M. resutor* as resembling the European *M. sutor*, "in many particulars," he says, "that it is not without considerable hesitation I describe it as distinct; it exhibits, however, some characters that seem to indicate more than a casual variety, produced by a difference of climate." He also says, that *resutor* is intermediate between *M. sutor* and *M. sartor*.

Calosoma scrutator occurs on the western frontier of Texas, and in Canada; it has been taken on the northern shores of Lake Ontario. *Chlœnius seriseus* occurs at Tampico, and is common throughout the Canadas. *Staphylinus villosus* occurs in Mexico and Cuba, and is also common throughout the United States and Canada. *Necrophorus obscurus* found in the valley of the Great Salt Lake of Utah, occurs in Canada. *Aphodius strigatus* found at Jalapa, occurs as far north as Lake Superior; also the European *Aphodius fimitarius* has its representative in America, and is found on the shores of Lake Superior. *Hister bimaculatus* is naturalized, but of rare occurrence in this vicinity. *Byrrhus varius* inhabits France and England; in North America it is common. *Byr. clyclophorus* occurs in Eastern Canada. *Pelidnota tripunctata* occurs at Fort Gates, Texas; its range has been traced northward to Niagara Falls, where it is found on grape-vines *Areoda lanigera* occurs at Santa Fé; is rarely found in Canada West, and probably its northern range terminates about the 44th parallel. *Clytus flexuosus* occurs at Fort Gates; its northern limit is confined to a species of Locust tree, on which it is a parasite in its *larva* stage. Mr. Harris

places *Pyrophorus noctilicus*, a West Indian insect, in the American fauna. The authors of "Melcheimer's Catalogue" reject it for want of proof as to its naturalization, probably attributing its introduction to accident. If Mr. H. really captured a living specimen in the U. States, his authority is quite sufficient.

A distribution of insects is also effected by means of importing cattle from one country to another. By this means, a few species of the Dipterous order of insects have been introduced into this country; one of these is the *Œstrus ovis.* Our sheep owners may be ignorant of the fact that this insect parasite is prolific in Canada, being a pest to sheep in winter as well as summer. Entomologists, by strict attention to the habits of this fly, have discovered the manner in which the species is propagated in the nostrils of the sheep. While the animal is grazing, the female fly watches an opportunity to alight on its nostrils deposit its eggs, which are placed in the frontal sinus, in the midst of the mucus which they contain. Each *larva* is provided with a pair of hooks to assist it in motion, and with which it inflicts wounds, and then feeds upon the matter generated therein. When the *larvæ* are full grown, they fall through the nostrils and change to *pupæ* on the surface of the earth. In March, 1856, five of the *larvæ* of this fly were taken from a sheep's head, obtained from the Toronto market. The party who purchased the head, did not know how "the worms," as he called them, got there, and made no use of it, being under the impression that the animal had died from disease. Sometimes the irritation produced by the *larvæ* is so excruciating that the animal runs about continually, rubbing its nose on the ground, and it frequently loses the power of its feet. There have been several instances in England which proved fatal. The disease is called "Staggers" by persons who are ignorant of the cause. The *larvæ* can be destroyed by injecting tobacco juice into the nostrils.

It is indeed probable that the Dipterous wheat parasite which is now propagating to an alarming extent in this country, and where it has done so much damage to the staff of life, may be traced to some European country in which it is attached to another species of cereal, and that naturalists take no more notice of it than that it does exist. Many species of all the orders of insects, while in the *larva* state, derive nourishment from more than a single vegetable substance; and any person who has studied Insect life, can see that every parent insect is

provided with instincts for the production of its species. If the insect is a parasite on two plants, it is not at a loss to discover one of them; but deprive it of one of these plants., and the result is that the remaining one suffers doubly. It is astonishing to witness the manœuvres of these minute animals to sustain nature. Every type of creation is destined to pass through its course of life; and we find, as one species becomes extinct, another hitherto unknown to us, springs up, as if by magic, in some other part of the globe, to fill up the vacancy. Of this wheat parasite I shall make some further remarks. It is not known at present; and until we do enquire into its origin and habits, much cannot be said of it.

ARTICLE VII.—*On the Natural History of the Rosignol or Song Sparrow, Fringilla melodia.*

This interesting little bird is one of the first to proclaim with his song the return of spring, with its wood-music, flowers and soft southern breezes. His note is no sooner heard than all nature seems to arouse itself from the torpor of winter and burst forth into an universal revivification. No Canadian can listen to the sweet ditty of the rosignol, at the same time recalling the incidents of his school-boy days, without feeling his heart warm towards the happy little creature. It is remarkable that with respect to so very common a bird, there should yet be a doubt as to its correct specific description. Audubon figures it with a black spot near the centre of the breast, but does not mention this spot in his summary of the characters of the species. He, however, quotes Dr. Brewer, who says that he has reason to believe that there are two birds included under the same appellation. One of these has the breast spotted nearly all over, while the other has the black star in the centre. He says, the latter builds its nest in bushes or young trees at least two feet from the ground, and the other always upon the ground. He says, the most common resort for nesting is a young cedar tree where the branches are very thick, and where he has twice found an arched entrance leading to it, and a cover to the nest, made by weaving straw and hay among the thick foliage of the tree. The eggs have a ground colour of green, which is perceptible all over the surface, not even excepting

the large end, where the spots of lilac brown with which the egg is spangled over, are the thickest. The egg of the other species or that which builds upon the ground, has a ground colour which appears to be white as far as can be seen, but the whole is so thickly spotted with blotches of a rusty brown as to appear almost wholly of that colour.

Both of these birds spend the summer in Canada, and their nests may be found in almost every meadow, both on the bushes and on the ground. We hope that some of our youthful readers may endeavour to solve the problem of "two species or one," during the approaching season.

The Rosignol, after leaving us in the autumn, passes into the Southern States, where these birds actually swarm during our winter months. This abundance, Audubon says, is easily "accounted for by the circumstance, that it rears three broods in the year; six in the first, five in the second, and three in the third brood, making fourteen per annum from a single pair. Supposing a couple to live in health and enjoy the comforts necessary for the bringing up of their young families, for a period of only ten years, which is a moderate estimate for birds of this class, you will readily conceive that a whole flock of sparrows may in a very short time be produced by them."

This bird, although it leaves the nest clean and perfect after the first brood, does not rear a second in the same domicile, but constructs a new one. It is made of fine grass, and nicely lined with hair, principally horse hair. Both birds assist in the process of incubation, and while one is in the nest, the other affectionately brings it food. While the female is sitting, the male sings to her from some neighbouring twig or fence rail. The flight of the song sparrow is short, and much undulated when the bird is high in the air, but swifter and more level when it is near the ground. They migrate by night, singly or in scattered troops. They feed on grass seeds, berries, insects, especially grass-hoppers, and now and then pursue flies on the wing. On the ground their motions are lively. They continue running about with great nimbleness and activity, and sometimes cross shallow waters leg deep. They often frequent orchards and gardens, where they love to breed if a secure corner can be found.

This bird sings the whole summer long, and until it takes its departure in the autumn. The notes or chant are short, but very sweet, resembling the beginning of the canary's song, and fre-

quently repeated, generally from the branches of a bush or a small tree, where it sits chanting for an hour together.

The song sparrow is usually called in Upper Canada the "grass bird" or "grey bird," a name that is also applied to another little fellow, who is frequently found building upon a tree close to the walls of some inhabited house. This, however, is the "chipping sparrow," a bird which, although it belongs to the family, has its place in another genus. It is the *Emberiza socialis* of Swainson, and may be recognised by its song "*sip-sip-sip-sip*, resembling, as Audubon says, "the sounds produced by smartly striking two pebbles together, each succeeding note rising in strength, although the song altogether is scarcely louder than the chirping of a cricket."

Of the genus to which the song sparrow belongs, four species only, visit Canada, and of these *Fringilla melodia* is the most common.

The following are the generic and specific characters:

CANADIAN SPARROWS.

[Class Aves, Order Insessores, Genus Fringilla, (Linn.)]

Bill short, stout, conical, somewhat compressed, pointed; upper mandible of the same breadth as the lower, with its dorsal line straight, the ridge indistinct, the sides rounded, the edges ascending at the base, the notches obsolete, the tip scarcely deflected; lower mandible with the angle very short and rounded, the dorsal line straight, the sides convex, the edges inflected, the tip acute Nostrils basal, roundish, concealed by the feathers. Head rather large, ovate; neck short; body compact. Legs of moderate length; tarsus rather short, compressed, with seven scutella; toes moderate; hind toe stout, lateral equal. Claws rather long, arched, compressed, acute. Plumage rather compact, but blended. Wings of moderate length, with the second, third, and fourth quills longest. Tail of moderate length, slightly emarginate. Roof of upper mandible moderately concave, with three longitudinal ridges; tongue compressed, channelled above, horny, rather obtuse and concave at the end; œsophagus dilated about the middle; stomach roundish, muscular; intestine rather short; cœca small.

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1. *Fringilla iliaca*, Merrem. Fox-coloured Finch.

Upper parts light red, claws long, hind toe and its claws of

equal length, tail lighter, the head and neck intermixed with light bluish-grey; inner webs of quills brown, secondary coverts slightly tipped with whitish; lower parts white, and, except the abdomen, spotted with light red, the spots on the breast smaller and inclining to black; a patch of dusky on its fore part, produced by the inner webs of several of the feathers.

Male, 7½, 10½. *Female*, 7½.

Dispersed in winter throughout the Southern and Western Districts. Breeds from Nova Scotia to Labrador and the Fur Countries. Rather common.

Fox-coloured Sparrow, Fringilla rufa, WILS. Amer. Orn. v. iii. p. 53.
Fringilla iliaca, BONAP. Syn. p. 112.
Fringilla (Zonotrichia) iliaca, SWAINS. & RICH F. Bor. Amer. v. ii. p. 257.
Ferruginous Finch, Fringilla iliaca, NUTT, Man. v. i. p. 614.
Fox-coloured Sparrow, Fringilla iliaca, AUD. Orn. Biog. v. ii. p. 58; v. v. p. 512.

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2. *Fringilla melodia*, WILS. Song Finch.

Hind toe and claw of equal length; upper parts yellowish-grey, streaked with brownish-black and brownish red; on the head three greyish-blue longitudinal bands; quills dusky brown, margined with brownish red, tail-feathers dull light brown, edged with lighter; sides of the head yellowish-grey, with two bands of dusky brown; throat white, with a broad band of dusky brown on each side; lower parts white, the fore neck and sides tinged with reddish, and streaked with dusky brown. Bill stouter than in the preceding species.

Male, 6, 8½.

Breeds from Texas to Nova Scotia. Not observed in Kentucky. Winter resident in the Southern States. Very abundant.

Fringilla melodia, WILS. Amer. Orn. v. ii. p. 125.
Fringilla melodia, BONAP. Syn. p. 108.
Common Song Sparrow, Fringilla melodia, NUTT. Man. v. i. p. 486.
Song Sparrow, Fringilla melodia, AUD. Orn. Biog. v. i. p. 226; v. v. p. 507.

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3. *Fringilla Pennsylvanica*, LATH. White-throated Finch.

Male with the bill dusky; the upper part of the head black, with a central white band; a bright yellow band from the nostril

to the eye, continued into a white band passing over and behind it, and margined beneath with black; fore part of back bright bay, streaked with dusky and reddish-yellow; rump yellowish-grey; edge of wing light yellow; quills brownish-black, primaries edged with yellowish-grey, secondaries and their coverts with light red; two narrow bands of white on the wings, formed by the tips of the secondary coverts, and first row of small coverts; tail-feathers brown, edged with rufous; throat white; cheeks, sides, and fore part of neck, and a portion of breast, ash-grey; the rest of the lower parts greyish-white, the sides tinged with yellowish-grey. Female similar, but with the colours duller.

Male, $6\frac{1}{2}$, 9. *Female*, $6\frac{1}{4}$, $8\frac{1}{2}$.

Winter resident from Louisiana to Maryland, and inland as far as Kentucky. Breeds from Maine to the Fur Countries. Abundant.

White-throated Sparrow, Fringilla albicollis, Wils. Amer. Orn. v. iii. p. 51.

Fringilla Pennsylvanica, Bonap. Syn. p. 108.

Fringilla (Zonotrichia) Pennsylvanica, White-throated Finch, Swains. & Rich. F. Bor. Amer. v. ii. p. 256.

White-throated Sparrow, Fringilla Pennsylvanica, Nutt. Man. v. i. p. 481.

White-throated Sparrow, Fringilla Pennsylvanica, Aud. Orn. Biog. v. 1. p. 42; v. v. p. 497.

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4. *Fringilla leucophrys*, Gmel. White-crowned Finch.

—White-crowned Sparrow.

Male with the bill yellowish-red tipped with brown; upper part of the head with four longitudinal black, and three white bands; fore part of the back streaked with reddish-brown and yellowish-grey; rump light yellowish-brown; quills dark brown, primaries edged with yellowish-grey, secondaries and their coverts with yellowish red; edge of wing whitish; two bands of white on the wing, formed by the tips of the secondary coverts and first row of small coverts; tail-feathers brown, edged with yellowish-brown; throat greyish-white; cheeks, sides, and fore part of the neck, and a portion of the breast, ash-grey; abdomen white, sides, and lower tail-coverts, yellowish-brown. Female similar to the male. Young in first plumage with the back, wings, and tail as in the adult, but duller, and the bands inconspicuous; on the head three

greyish-white bands, streaked with dusky, and four dull greyish-brown bands similarly streaked; cheeks, sides, and fore part of the neck, with a portion of the breast, dull greyish-white, streaked with dusky, the rest of the lower parts dull yellowish-white. At the second moult the colours approximate to those of the old bird, but the central band on the head is dull yellowish-brown, the lateral bands brownish-red; while the lower parts are of much duller tints.

Male, 7½, 10½.

Breeds from Newfoundland and Labrador northward. Abundant. Migratory. Passes southward in autumn beyond the Texas.

White-crowned Bunting, Emberiza leucophrys, WILS. Amer. Orn. v. iv. p. 49.

Fringilla leucophrys, BONAP. Syn. p. 479.

Fringilla (Zonotrichia) leucophrys, White-crowned Finch, SWAINS. & RICH. F. Bor. Amer. v. ii. p. 255.

White-crowned Bunting or Finch, NUTT. Man. v. i. p. 479.

White-crowned Sparrow, Fringilla leucophrys, AUD. Orn. Biog. v. ii. p. 88; v. v. p. 515.

The above descriptions are from Audubon's Synopsis.

ARTICLE VIII.—*On the Minerals of Canada. A Lecture by* PROFESSOR HIND, TRINITY COLLEGE, *Toronto.**

MINERALS OF CANADA.

PROFESSOR HIND'S SECOND LECTURE.

The vast areas occupied by the rocks yielding Gypsum with brine springs in Western Canada have for many years been regarded as sources of great national wealth. Gypsum, or Sulphate of Lime, is used in the Arts for numerous purposes. Our gypsiferous and brine-yielding rocks extend from the Niagara to the Saugeen, and have a breadth varying from five to fifteen, and even twenty miles. Gypsum has been quarried in the Townships of Dumfries, Brantford, Oneida, Cayuga and others in the valley of the Grand River. It will, probably, be found in great abundance

* Extracted from the Toronto *Daily Colonist* of 21st February, 1857.

in the valley of the Saugeen when that fertile tract of country becomes better known. "Apart from domestic consumption, the Townships of Oneida and Cayuga, furnished in 1854, 7,000 tons of gypsum for exportation to the United States. These gypsums are of recent origin; they occur in the form of mounds, which penetrate the palœzoic strata, and the overlying clays of recent date. The beds of lime-stone which surround them are upraised, broken, and in great part absorbed. Mr. S. Hunt, of the Geological Commission has shown that these phenomena are due to certain springs containing free sulphuric acid, which acting upon the carbonate of lime, has changed it into gypsum."

In the arts gypsum is employed by potters for procuring moulds with its calcined powder, moistened with a proper quantity of water. The finer kinds are selected for the manufacture of the alabaster ornaments so much admired. When properly calcined and ground to a fine powder, it is largely employed for stucco work, statues and statuettes; when mixed with glue or gelatine, coloured stuccoes of great hardness and beauty are made from it. It is admirably adapted for taking casts of objects, and is frequently employed for that purpose. Gypsum is commonly known under the name of Plaster of Paris; vast quantities of this substance being found in the neighborhood of the French Capital, and a large quantity of the material is prepared there for home consumption and exportation. Gypsum is the basis of Keen's, Martin's Parian cement; the material is thrown into a saturated solution of Alum, Sulphate of Potash or Borax; after soaking, it is air-dried, and rebaked at a low red heat. When Borax is used, plaster is called Parian; when Sulphate of Potash is employed, it is styled Keene's cement; and when made with Pearl-ash and Alum together, and baked at a higher temperature it is designated Martin's cement. In England, the Gypsum for these purposes is obtained from Nottinghamshire, Derbyshire, and Cumberland. An immense number and variety of articles manufactured from Gypsum, with small additions of the substances before mentioned, were exhibited at the London and Paris exhibitions. The subject is one of general interest, and the vast deposits of Gypsum in Canada will, no doubt, become considerable sources of national wealth, when the proper times arrives.

For Agricultural purposes, the value of Gypsum is too well known to require much notice here; a growing appreciation of its worth is shewn in the yearly increasing demand, and it is now

found for sale in large quantities in most Canadian towns. It is a fact ascertained by the experience of very many years in France and Germany, and more lately America, that Gypsum judiciously applied, sometimes doubles, and even trebles the quantity of certain plants usually grown upon an acre; a study of the mode and time of applying it, and of the plants most benefited by it ought not to be lost sight of in Canada, where it so largely abounds in the District between Niagara river and the Indian Peninsula of Lake Huron. The value of the exports from Canada of ground plaster and lime show a steady and important increase. In 1853, the total value was only £1340 Cy., in 1854 £2017, and in 1855 £19,112.

BRINE SPRINGS.

In describing the great extent of the Gypsum and Brine bearing rocks of Canada, it is possible to speak only with comparative certainty of their economic value with respect to Gypsum. Although Brine springs may be common and apparently sufficiently strong to warrant the commencement of working operations, yet failure and disappointment have so often resulted from unfortunate attempts in New York, and even in Canada, that actual experience resulting from trial is the only sure indication of success. In this group of rocks, brine springs occur abundantly in the region between the valley of the Grand River and the Indian Peninsula, and in the eastern prolongation of the same rocks enormous quantities of salt have been made at Salina.

The vast extent of country not hitherto thoroughly examined but occupied by the salt-bearing rocks, leaves it extremely probable, but only extremely probable, that brine springs sufficiently strong for manufacturing purposes will be found and worked west and north-west of Hamilton. The question is one of much commercial interest, and is represented in our annual expenditure by the sum of £51,320, which we pay to the United States, and £13,977 to Great Britain, making, with other small importations of the same material, the total amount of £69,-209, representing 1,687,926 bushels of salt in 1855.

MARBLES.

Statuary marble is a material employed in an art which no one can expect to find exercised to a large extent in Canada in the infancy of the country; it is evident, therefore, that the finer kinds

we possess, may derive value from the creation of a demand for them as raw material abroad, where mechanical labour is less proportionately valuable, and where cultivated taste in execution may succeed in imparting to them a value which their natural beauty serves only to heighten. The coarser kinds of marble will acquire continually increasing value with us, as the wealth of the country increases, and facilities for carriage extend into the regions where Canadian marbles are to be found.

In the Eastern townships there are very extensive ranges of serpentines, affording beautiful varieties of marbles, specimens of which attracted considerable attention in England, in 1851. Sir W. Logan thus notices this important and extensive range:—

"Several considerable blocks of limestone and serpentine, fit for the purposes of marble, carried across the Atlantic in the rough, were sawed and polished in London. They were all from the eastern townships, and though selected hastily and without previous trial of the stone, most of them gave very fair results, and one of the serpentines from Brompton Lake, shewing a dark green ground with black spots, was of a peculiar beautiful character. I was informed by the marble manufacturer, a highly respectable one, who cut the stone, that large blocks of such a description would command a ready sale in the metropolis, and when we consider the great extent to which the serpentine ranges through the townships, 145 miles, the results of these trails give hopes that much stone of a valuable description may be obtained from that region.

Among the localities where marbles have been found and examined by the members of the Geological Commission—are for white marble—Lake Mazinaw and Philipsburg; black, Cornwall and Philipsburg; red, St. Lin; brown, Packenham; yellow, and black, Dudswell; grey and variegated, Macnab, Philipsburg, St. Dominique, Montreal; green, Grenville and along a serpentine range before mentioned extending for 150 miles in the eastern townships. In the "Sketch of the Geology of Canada," these green marbles are mentioned in the following terms:—The serpentines throughout their whole extent, furnish very beautiful dark green marble often resembling the *vert-antique ;* green serpentines of various shades are mingled with white and grayish limestones, giving rise to many varieties of these marbles, the finest of which are from Broughton and Oxford. Near Philipsburg, the Trenton limestone afford a fine white marble; in their southern prolonga-

tion, these limestones become more crystalline, and form the white marbles of Vermont, which are now celebrated. The upper silurian limestone of Dudswell are greyish and yellowish, with veins and spots of black, they still exhibit on their polished surfaces, the traces of fossils, and often form marbles of great beauty.

The specimens upon the table were from Madoc; a considerable abundance of coarsely crystalline marble occurs in those back townships, and as the country becomes cleared and known, more of better quality will probably be found.

The process of turning and polishing marbles by means of a common lathe is not generally known, and may therefore be briefly noticed. A piece of marble of the size required is selected free from veins and cracks. The first operation is to chisel it roughly to a cylinder form. It is then fastened by resinous cement to the lathe and subjected to a slow revolving motion. The tool used is a bar of iron about 30 inches long and pointed, this is forcibly applied to the revolving cylinder of marble, which it gradually reduces to its required form. A coarse sandstone with plenty of water is next applied; the cylinder of marble being made to revolve much more quickly. The tool marks disappear under this process. A finer piece of sandstone is then employed to remove the scratches of the preceding one, and so on with still finer stones, until all scratches are quite obliterated. In polishing, a piece of of cotton cloth rubbed with flour emery is used; and, finally, a similiar piece of cloth rubbed over with tin putty gives a very high polish, and completes the process.

SLATE.

Slate is a material daily becoming more valuable on account of the vast variety of useful purposes to which it is applied. One of its most important characteristics is its strengh, it is computed to be about four times as strong as ordinary stone, and slabs 8 feet long and upwards can be safely used of thicknesses not exceeding half an inch. It is a non-absorbent of moisture and thus adapted as a admirable lining for wells and for roofing houses. The slates which were taken to the London Exhibition from Canada were not good representations of the material since found to exist in this country. The economical importance of slates has attacted attention to their distribution in Lower Canada, and already large quarries are worked which furnish slate of superior quality. Some

of the quarries are wrought on rocks of the same geological epoch as those which underlie the clay on which Toronto is built, altered however by heat. The numerous applications of this entirely useful material have been alluded at some length by Sir W. Logan in his Geological Report:

"Not only is it applied as a covering for houses, but it is employed as walls for cisterns to hold water, slabs of fifteen feet by eight feet being sometimes used for the purpose: in smaller dimensions, it is used for wine coolers, dairy dressers, kitchen and hall flooring, tables, chimney mantles, and a multitude of other purposes where surface is required. In its application as tables and chimney pieces, it is capable of receiving a great degree of decoration; the tables after being dressed to the smoothest possible surface, are embellished with gilding or with paintings in colors resisting fire, showing landscapes, or imitations of stone, and a silicious varnish being applied, the stone subjected to a heat which melts the varnish into an enamel, and produces a brilliant result. Chimney pieces in the same way are enamelled over the natural colour of the stone, or over a fancy colour given to it. When the colour is black, it is difficult to distinguish the slate from a brilliantly polished and valuable black marble, while the cost is comparatively small. The great number of purposes to which good slate is applicable, render the rock of great economic importance, and well worthy of research."

HYDRAULIC LIMESTONES.

The term hydraulic limestone is very frequently met with in accounts of the construction of reservoirs, canals, water-tanks, cellars, and a host of other artifices of public utility and domestic comfort. Often, indeed, these fail to secure the object for which they are designed, as many of the public works in the United States testify. This arises from a misconception of the nature of an hydraulic limestone, and of the effect which time and exposure are capable of producing upon different varieties. This subject has been much studied in Europe by the ablest chemists, but not with those clear and satisfactory results which so frequently distinguish the progress of modern science. Mortars and hydraulic cements may be thus distinguished:—

1. Common limestone, such as the limestone from Kingston, or the quarries on the western extension of the Grand Trunk, is exposed to a heat sufficient to drive off the carbonic acid it contains; it

then acquires the power of absorbing water in the proportion of 9 pounds of water to 28 pounds of lime, with the evolution of much heat. If this lime is mixed with sand to the extent of two or three times the weight of the lime, and water added, a mortar is formed which possesses the property of hardening in dry air or between dry bricks, imperfectly hardening in damp air, and refusing altogether to become consolidated under the surface of water.

2. Water Limes or Hydraulic Limes, or Cement, are those which possess the property, after they have been properly burned, of hardening under water without admixture with any other substance.

The simplest form of an hydraulic lime, is common lime mixed with 10, 15 or 20 per cent. of clay, or clay and magnesia, or a little clay, sand and magnesia. With such a compound, when calcination or burning is not carried too far, a good and durable cement is obtained, setting under water in periods varying from a few hours to a week or more, and at the end of some months becoming harder than many common limestones.

Many calcareous clays or argillaceous limestones exist in nature possessing these properties, these are called hydraulic limestones, because when they are partially burned they possess the property of setting under water. Many limestones which are used for hydraulic purposes, possess the very detrimental quality of containing portions of lime after they are burned, which slake at a period snbsequent to their use. The mortar or cement then falls to pieces and becomes not only useless, but absolutely injurious.

Limestone, containing the proper admixture of the materials enumerated, exists in many parts of Canada; at Paris, Cayuga, Thorold, Kingston, Loughboro', Hull, Quebec and elsewhere. In some of these localities the beds have been worked; those of Hull are of excellent quality and highly esteemed. This bed is characterized by the proximity of a layer filled with a particular shell, and has been traced chiefly by means of this shell over a large area, and it is the continuation of the same bed which furnishes the hydraulic lime of Kingston and Loughboro'.

In the United States the preparation of hydraulic cement of different qualities, is already a manufacture of considerable importance.

So far back as 1840, there were 60 kilns for the manufacture of cement, in the vicinity of Kingston, Rosendale, Lawrenceville, and High Falls, in the State of New York. In that year it was

estimated that 600,000 barrels were sent to market from those kilns. It is shipped to all American Atlantic ports and the West Indies. From that period it is almost needless to say that the production of hydraulic cement, in the United States, has immensely increased.

Many of the Canadian beds of water lime appear to be of excellent quality; they are generally distributed through the country, from the valley of the Grand River to the Saugeen. Trials have been made by Mr. Hunt, on a specimen from near Brantford, which, in five minutes, set under water.

OCHRES.

Ochre used as a paint, is of growing importance on this continent. So many of our structures are built of wood, that their preservation from the air, and a desire to give them a suitable and agreeable appearance, naturally leads to their being covered with some material possessing the required properties. Ochres of different tints are largely used for this purpose. Canada imports a very considerable quantity of ochre in a manufactured state, and yet possesses within her borders, very extensive and valuable deposists of this mineral. The exhibition of ochres at Montreal in 1850 attracted the attention of a stranger, who enquired of Sir W. Logan, where they came from; he was informed of the position, and of the means of obtaining access to them. The stranger, knowing the value of the deposit, immediately secured the property on which it was found. In 1852-53 Sir W. Logan relates the subsequent history of this ochre bed, which affords one instance out of hundreds, which have occurred in Canada, of foreigners familiar with the value of some of our natural products, and acquiring knowledge of their extent and distribution appropriating, and with perfect justice, the gain to themselves.

"A very large ochre bed is situated on the St. Nicholas range of Pointe-du-Lac, on the property of Mr. Piere Chaillon and his brother. It is crossed by the range road, running north westward, over a mile from the point where starts from the water-side road; the deposit extend on each side of the road, about ten acres to the south-west, and forty acres to the north-east; the breadth is irregular, and varies from one to twenty acres, and the whole area may be about 400 acres; the thickness of the deposit ranges from six inches to four feet, and may have an average of about eighteen

inches. The prevailing colors of the ochres are red and yellow, but there occurs also in some parts a beautiful purple tinge, and in others a blackish-brown. At the Industrial Exhibition which took place in Montreal, in October 1850, some of the ochres of this locality presented to the public view by Mr. D. G. Labarre, attracted the attention of persons acquainted with the commercial value of such products, and arrangements were subsequently made with the proprietors of the land, by Messrs. H. A. Munroe & Co., of New York, for the purpose of entering upon such a preparation of the crude material as should fit it for sale. With this view, a couple of furnaces have been erected in the vicinity of the ochre bed, and an agent established to carry out the details of the manufacture, and attend to the forwarding of the article to New York, where the sale of it is effected. I was given to understand by the agent, that 400 barrels of the ochre had been disposed of at five dollars each, and that as many as twelve barrels had occasionally been prepared in a day. From the few natural colors that have been mentioned, eight tints are said to be prepared. The deposit being but little mixed with sand, the chief impurity to be got rid of consists of the roots of those plants which have been growing on the surface, some of which penetrate to a considerable depth. Two modes are resorted to for this purpose; one is by dry sifting, which is used where the natural colors of the ochres are to be preserved, as in the case of the yellow variety, of the purple, and of the blackish brown. The yellow is a hydrated peroxyd of iron, the purple also is probably in some peculiar state of hydration, but the red is the anhydrous peroxyd. By exposure to a sufficient heat in the furnace, the water of combination is driven off from the yellow and purple, and both becoming anhydrous peroxyd, assume the tint of the natural red ochre, from which, as from the other two, the vegetable matter in this operation is burnt out. The blackish-brown variety is scarcer than the others, and affords colors of a more valuable description; purified from roots without fire, it is sold under the name of raw sienna; it is admirably adapted for graining, and brings in retail, I am informed, so much as a shilling the pound. When subjected to fire, it assumes brown of less intensity, and it is sold as burnt sienna. As it does not turn red from burning, it is probable that there may be in this ochre, an admixture of manganese."

In the St. Malo range of the Seigneury of Cap-de-la-Madeleine a great deposit of ochre occurs. The area occupies upwards of

600 acres. It is underlaid by peat, the fuel sufficiently well adapted to prepare it for the market. This and many other locaties in Lower Canada, as well as in Upper Canada, contain inexhaustible quantities of ochre, some of excellent quality and of a great variety of colours.

STEATITE.

Steatite or soap stone, composed of flint and magnesia, possesses many singular properties which are gradually introducing the material into notice and use. It is generally soft to the touch, scarcely affected by acids, and little changed by exposure to intense heat.—In Maryland a steatite or soap-stone company exists, and manufactures a surprising number of articles for economical purposes. In addition to the properties before enumerated, the remarkable ease with which steatite is worked by common carpenters' tools, render it an object admirably adapted for may operations to which other materials are not applicable. A substance almost indestructible by fire and many strong acids, and so soft as to admit of being turned, bored, screwed together and planed, is well worthy of attention.

In Canada it is found and used as a refractory stone in the township of Vaudreuil, Beauce, Wotton and Ireland; it exists also in Sutton, Bolton and Melbourne; it also exists in the township of Leeds and Stanstead, where it is ground and employed as a paint.

The brief and necessarily imperfect sketch I have now given of the most important minerals hitherto found in Canadian rocks may serve to convey a tolerable impression of what our country offers to mining enterprise and industry. We must, however, in justice to that large extent of territory which constitutes our main mineral region, bear in mind that it is, in great part, still an uncultivated and but partially explored wilderness.

It was said by one, far above his fellowmen in acquirements, and in the additions he had made to human knowledge, that when at the close of a long life, he contemplated the work he had done, "he seemed like a child to have been gathering pebbles on the sea shore, with the vast ocean of truth lying unexplored before him." We may, with some semblance of propriety, apply this beautiful simile to our present acquaintance with the stores of inert wealth which lie hidden in the rocks of the unsettled parts of our country. Although the information which has been given to the world by the geological commission is of the highest national value, and in

amount, far greater than was ever expected to be acquired in so short a period, over a country so extensive and little known, and with means so inadequate to the end, yet it is not to be understood that discoveries equal in importance to those already made may not year by year inform us of fresh treasures before unthought of. It is only the other day that a band of rock was discovered, so admirably adapted to the milling purposes for which Burrstones are employed, that we may not only become independent of foreigners for that important article, but enabled to export them to other countries.

The discovery of hydraulic lime in some of the strata on which the city of Quebec stands tells, by means of a geological knowledge of the country, of the existence of hydraulic lime for hundreds of miles. The ascertained southern limits of the Huronian copper bearing rocks on lake Huron and Superior indicate a copper yielding country in which a search for that metal may be prosecuted over many thousand square miles with every prospect of success.

The influence indeed of a single discovery of an economic material in any strata acquires importance which cannot easily be estimated, when the known extent of the rock which holds it occupies wide areas. It is for this purpose that a general study of geological outlines of the country is so useful, and in our time even necessary. Think of the advantage to the settlers in the Ottawa region to know of the existence of Crystalline Limestones beneath their feet, over which they have been many years journeying 15 and 20 miles for the same indispensable material to the great River Ottawa itself, where it is exposed in a form to which they have been accustomed. But expand the ideas conveyed in this simple announcement to the whole region in Canada where it may apply, and we find that a knowledge of the structure of the Laurentian Rocks, which extend from Labrador to Lake Huron, and thence on towards the Mackenzie River, tells us of the existence of Crystalline Limestone throughout the whole of the vast country and limestone is an indispensable necessity of civilized life. But we may amplify still further and point to the iron ores generally associated with these limestones. I have spoken in a former lecture of the vast magnetic beds, of Marmora, Madoc, Belmont and Hull; these are generally found in juxta-position with beds of crystalline limestone. When this great fact becomes generally known among future settlers in the Laurentine Country, and they

are made aware of its applicability to the extensive areas between the Ottawa and Lake Huron and elsewhere, it becomes almost a matter of certainty that the large rivers traversing this region may thus be made accessible and of commercial value. Consider again the lime and soda felspar rocks which throughout the Laurentine Country are associated with the crystalline limestone, and remembering the words of Sir William Logan, we shall not despair of, but rather hope well for, this vast uninhabited region. The vallies underlaid by these lime and soda felspars guarantee a fertile soil and agricultural capability, wherever they are to be found, and the discovery of important ranges in the Laurentine Country establishes this capability over wide areas. It is of the highest importance to give due prominence to this part, for an impression has prevailed almost universally that the Laurentine Country, now comprising the unsurveyed part of Canada, is hopelessly sterile, and consequently incapable of supporting agricultural people so necessary in the proximity of a great mining district. Whereas the real facts of the case, when fully known, show conclusively that not only in the river vallies but over extensive ranges occupied by particular rocks, all the elements of fertility exist in singular abundance, and that it requires only the industrious hand of man to convert wide areas in those unoccupied solitudes into cultivated and fruitful farms.

ARTICLE IX.—*Quarterly Journal of Microscopical Science.*

No. 18, January, 1857, p.p. 114, with six plates. London: John Churchill, 4s.

CONTENTS.

On Striated Muscular Fibres in the Skin of the Human Lip; by Dr. Woodham Webb, London.

Translations, Notes and Correspondence, and Proceedings of the Microscopical Society.

This is an average number. From the notes we select the following communication addressed to the editors, which may prove interesting to microscopists among ourselves.

"Allow me to call your attention, and that of your readers, to a little contrivance of mine, which may be found useful."

"It is a simple apparatus for illuminating objects under the microscope, and will be found particularly of use when examining Diatomaceæ. Knowing that there are many microscopical observers like myself, not able to expend large sums in accessory apparatus to the microscope, I particularly recommend it to their notice.

It consists of a plate of glass, (fig. 1) (an ordinary slider,) three inches by one; to one side of which, in the centre, is attached, by

Fig. 1.

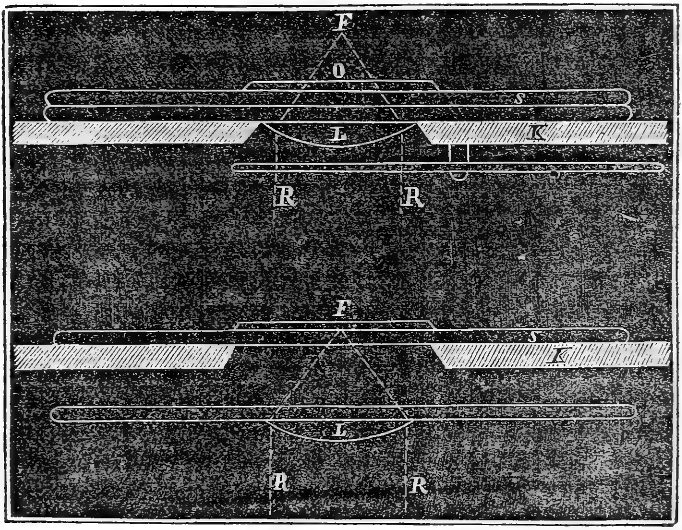
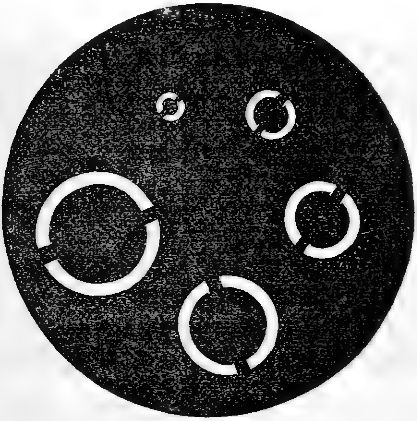


Fig. 2

Canada balsam, a *plano convex* lens (L) and this may be of about one quarter-inch focus. Lenses of different powers can be used although I have found one of half-inch, and one of a quarter-inch focus to be the most useful. The way in which this is used is seen in the first figure. The rays of light (R) fall on the lens (L)

placed on the microscope stage (K), so that the flat side is uppermost, upon which is placed the object to be examined. The rays are brought to a focus (F), at some distance above the object (O), thus giving an even white light over the whole field of vision, and this I have found particularly advantageous when using low powers for viewing objects. We can modify this arrangement by placing the lens below the stage, (as in fig. 2), and at a point where it can be adjusted by a rack and pinion, so that the rays from it are focussed on the object However, the first arrangement I have found the most generally useful. To this can be added a diaphragm (fig. 3), which any one can make for himself, to fit the microscope, of blackened card-board. The general utility and cheapness of this simple contrivance will, I think, recommend it to the consideration of all whose purses are not as large as their desire for knowledge.

Fig. 3.



I should also mention that I have found this illuminator particularly useful on dull days, when, by the mirror alone, only a gray light could be obtained, while with the addition of my condensing lens a clear white light is obtained, and from the reason of most of the rays falling obliquely on the object, the markings of certain of the Diatomaceæ can be easily resolved with it. When the diaphragm (fig. 3) is added, with its numerous apertures, and which can be varied to suit the fancy, we get an apparatus which, on important occasions, will be found to fill the place of the more expensive achromatic condenser.

E ARTHUR M. EDWARDS, *New York.*

Miscellanies.

THE LATE MR. HUGH MILLER.

" Hugh Miller," (writes the accomplished Editor of Silliman's Journal,) " one of the best known and most honored of Scotland's sons died at Shrub Mount, Portobello near Edinburgh, on Wednesday the 24th December. In consequence of excessive mental labor, his mind had become disordered, and under derangement, he died by his own hand. He had just finished a new work, one of a series that has done *more than all else published in the world* to popularize and christianize science; and he leaves this "Testimony of the Rocks" as a testimony to his own greatness and goodness of soul, as well as to the treasures of wisdom in the volume of creation which he so delightingly read."

The italics are our own. We cull from recent Scotch papers the following accounts of this sad event: * * * * * *

(*From the Scotsman.*)

" Rarely are we called upon to perform a duty so painful, alike in itself, and in the sudden circumstances of its occurrence, as to record the death of Hugh Miller. His name, as editor of the *Witness*, as a man of science, and as a genial and admirable writer on social andliterary topies, is known wherever our recent literature itself is known; and in Edinbugh, the city of his adoption, and nursery of his talents and reputation, his death is felt and mourned as a public loss. However sadly the narrative of his death may touch Mr. Miller's immediate friends, is will be to them less startling than to others unaware of his peculiar temperament, and of his recent state of health as a sufferer from nervous depression and irritation."

" Mr. Miller has fallen a victim to overwork of the brain, the peculiar malady of these days, and of men of his class. Such, we know, was and had long been his own conviction. Years ago, and again within these two or three days, he was pleased in the goodness of his heart, to warn the writer of these few hasty and halting words against what he thought dangers of that class, pointing to his own case as an example deterring from continous efforts and anxieties.

In this respect, however, Mr Miller suffered, we suspect, from a somewhat peculiar temperament—he did not work *easy*, but with laborious special preparation, and then with throes that tortured him during the process, and left him exhausted afterwards. In saying this, however, we speak only of the more recent years; and it is at least six or seven years since we heard him complain that hard work had left him only *half a man*, and that he could do only half work with double toil."

"Although apparently a man of physical as well as moral courage, he had a curious tendency to keep fire-arms about his house and person. When he lived at Sylvan Place, to the south of the Meadows, he was accustomed, when going home after nightfall, to carry a loaded pistol, and from some allusions in his work—"First Impressions of England"—it appears that he followed the same practice when travelling, or at least when on his pedestrian excursions.

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To that habit, we have apparently in great part to ascribe the event we to-day deplore, and which a large proportion of the Scottish people will hear with startling and grief."

* * * * * * * *

"Beginning his literary career as a correspondent of the *Inverness Courier*—whose accomplished editor will be among his sincerest lamenters—he asserted his claims as a delightful sketcher of manners and of natural scenery and objects, and next as a powerful writer on ecclesiastical politics. It was only when the comparative ease and leisure he enjoyed as editor of the *Witness* enabled him to follow the natural bent of his inclinations and genius, that he developed that power of observation and research which he had cultivated, almost furtively, throughout his whole career, that he became known as a discoverer in science, and as one of the most felicitous of its popular illustrators. He was born in October 1802, as he himself tells us in the fascinating narrative of his life already alluded to. He has thus been cut off at the early age of fifty-four, while engaged on works to which he had devoted years of toil and research, and from which the geological world expected a rich harvest of new ideas and valuable results. His "Scenes and Legends of the North of Scotland," published about twenty years ago, (which was intended for a narrow circle,) revealed his poetical imagination and his extraordinary power of writing. The "Old Red Sandstone," published in 1841, while it placed him in the first class of geologists, and made his name known over Europe as a man of science,

charmed even ordinary readers by the fascination of its style. In 1849 he published "Footprints of the Creator, or the Asterolepis of Stromness," one object of which was to expose the flimsy sophistry, —and what he deemed the atheistical tendency—of the "Vestiges of the Natural History of Creation." It is ably reasoned, and—like his other works—beautifully written. Besides these, (and passing over his articles in the *Witness*,) he published a small volume—"First Impressions of England"—we think about eight or nine years ago. Many of his geological papers, scattered through the columns of the *Witness*, and no doubt others still existing in manuscript, he intended to publish in a more accessible form; and deep will be the disappointment caused by his death among the wide circle of his admirers, who yet expected many works, to instruct and delight, from his pen. His wonderful command of the English language, and the charms of his style, drew a glowing tribute to his eloquence from Dr. Buckland (himself a first-rate writer), which has often been quoted, 'I would give my left hand to possess such powers of description as this man; and if it please Providence to spare his useful life, he, if any one, will certainly render the science attractive and popular, and do equal service to Theology and Geology.'

"Bred a mason, with only common education, he raised himself by his native talent, from a humble rank of life to a distinguished place among the best writers and most scientific thinkers of the age. His country will long honour him as a noble example of a self-educated Scotsman."

From the Edinburgh News.

* * * * "His published works contain but a fraction of the labours of his lifetime. For many years past he has been one of the most energetic members of the Royal Physical Society, at whose meetings he from time to time made known the progress of his researches. Were these papers collected, they would form several goodly volumes. But their author studiously refrained from publishing them, save occasionally in the columns of the *Witness* newspaper. It was his intention that they should each form a part of the great work of his life, to which for many years his leisure moments had been devoted. His design was to combine the results of all his labours among the different rock formations of Scotland into one grand picture of the geological history of our country. For this end he had explored a large part of the Scottish

counties, anxious that his statements should rest as far as possible upon the authority of his own personal investigation. His knowledge of the geology of the country was thus far more extensive than was generally supposed. We may refer particularly to that branch of it on which he bestowed the unremitted attention of his closing years—the palæontological history of the glacial beds—that strange and as yet almost unknown period that ushered in the existing creation. He studied it minutely along the shores of the Moray Firth, on the east coast of Scotland, along the shores of Fife and the Lothians, and on the coast of Ayrshire and the Firth of Clyde. This last summer he made a tour through the centre of the island, and obtained boreal shells at Buchlyvie in Stirlingshire—the *omphalos* of Scotland. The importance of this discovery, in connection with those he had previously made in following the same chain of evidence can only be appreciated by those who have paid some attention to geology. We may state briefly that it proves the central area of Scotland to have been submerged beneath an icy sea, and icebergs to have grated along over what is now the busy valley of the Forth and Clyde, while the waters were tenanted by shells at present found only in the Northern Ocean. A large part of his work is written, though it is to be feared that much knowledge, amassed in the course of its preparation, has perished with him. In particular, there were whole sections of his museum understood only by himself. Every little fragment had its story, and contributed its quota of evidence to the truth of his descriptions. There is perhaps but another mind in Britain,—that of Sir Philip Egerton,—that can catch up the thread, and read off, though with difficulty, the meaning of those carefully arranged fragments. Yet, even with such aid, much must long, if not for ever, remain dark and obscure. The work on which he was more immediately engaged at the time of his death was partly theological, partly scientific. It was to embrace the substance of some lectures lately delivered, and a paper read last year before the British Association at Glasgow, on the fossil plants collected by himself from the Olite and Old Red Sandstone of Scotland. It was likewise to contain the figures of some thirty or forty hitherto undescribed species of vegetables. We hope that, as it was all but ready for publication, it may yet be given to the world."

(*From the Scottish Guardian.*)

* * * * * * * "To Mr Miller, more than to any other geologist, undoubtedly belongs the honour of having demonstrated, what previous observers had begun to suspect, that the Old Red Sandstone was entitled to rank as an independent formation, by its distinctive fossils, many of which he was the first to discover and describe. Mr Miller had projected and had advanced far in the preparation of, a work on the general geology of Scotland; but it is with the Old Red Sandstone that his name as a geologist will be permanently connected. The work in which he traces the progress of his observations, has been probably perused more for its moral interest and its literary excellences than even for its geogolical descriptions. It is such a book as Oliver Goldsmith might have written, had he been a naturalist, which he was not; but still when Goldsmith wrote on natural history, he threw the natural historians into the shade by his marvellous powers of description; and of all the writers of the golden age of British literature, it has always appeared to us that Mr Miller's style came nearest to the exquisite English of Goldsmith. To Mr Miller's versatile talents, and the varied contributions of his pen to criticism, art, philosophy, and science, is applicable also more than to any other writer of the day, the panegyric pronounced upon Goldsmith, that there was no branch of knowledge which he did not touch, and which, touching, he did not adorn. His most profound work, the "Footprints of the Creator or the Asterolepis of Stromness," is a contribution to natural theology of inestimable importance. It has been adopted as a text book by some of the most eminent teachers of geology in the Universities; and it has done more to expose the atheistical fallacies and sophistries of the "Vestiges of the Natural History of Creation" than even the elaborate essays of Sedgwick and Brewster."

"But to other and abler pens must be assigned the task of estimating the genius, the character, and the services to religion, science, literature, and social progress of this marvellous man. We must content ourselves with these brief and hasty recollections of his life and labours, in recording the unexpected and sorrowful intelligence of his death. Thousands here and in other lands will join with us in the tribute of an honest tear to the memory of a man of true heart and noble powers of intellect, devoted to the loftiest purposes. Little did we think, when we met Mr.

Miller last year, in the genial and kindly intercourse of the British Association, that we were to see his face no more; and that at the early age of fifty-four, he would be lost to the Church which he loved, and to the cause of Christian science, which owes so much to his example and labours. Death has made sad inroads of late years upon the ranks of the cultivators of natural science. Dr. Landsborough, Professor Edward Forbes, Dr. Johnston of Berwick, Mr. Yarrell, and now Mr. Hugh Miller, have passed away in rapid succession,—and Forbes and Miller have left behind them no equals."

We conclude our extracts with the following from the pen of the Rev. Dr. Hanna, in "The Witness," Mr. Miller's newspaper. "But Mr Miller was far more than a Free Churchman, and did for the Christianity of his country and the world, a far higher service than any which in that simple character and office was rendered by him. There was nothing in him of the spirit and temper of the sectarian. He breathed too broad an atmosphere to live and move within such narrow bounds. In the heat of the conflict there may have been too much occasionally of the partizan; and in the pleasure that the sweep and stroke of his intellectual tomahawk gave to him who wielded it, he may have forgotten at times the pain inflicted where it fell; but let his writings before and after the Disruption be now consulted, and it will be found that it was mainly because of his firm belief, whether right or wrong, that the interests of vital godliness were wrapped up in it, that he took his stand, and played his conspicuous part, in the ecclesiastical conflict. It is well known that for some time past,—for reasons to which it would be altogether unseasonable to allude,—he has ceased to take any active part in ecclesiastical affairs. He had retired even, in a great measure, from the field of general literature, to devote himself to the study of Geology. His past labours in this department,—enough to give him a high and honoured place among its most distinguished cultivators, — he looked upon but as his training for the great life-work he had marked out for himself,—the full investigation and illustration of the Geology of Scotland. He had large materials already collected for this work; and it was his intention, after completing that volume which has happily been left in so finished a state, to set himself to their arrangement. The friends of science in many lands will mourn over the incompleted project which, however ably it may hereafter be accomplished by another, it were vain to

hope shall ever be so accomplished as it should have been by one, who united in himself the power of accurate observation, of logical deduction, of broad generalization, and of pictorial and poetic representation. But the friends of Christianity cannot regret, that since it was the mysterious decree of Heaven that he should prematurely fall,— his work as a pure Geologist not half done,—he should have been led aside by the publication of the Vestiges of Creation to that track of semi-theological, semi-scientific research to which his later studies and later writings have been devoted. That, as it now seems to us, was the great work which it was given him on earth to do,—to illustrate the perfect harmony of all that science tells us of the physical structure and history of our globe, with all that the Bible tells of the creation and government of this earth by and through Christ Jesus our Lord. The establishment and exhibition of that harmony was a task for which, is it too much to say, that there was no man living so competent as he? We leave it to the future to declare how much he has done by his writings to fulfil that task; but mourning, as we now can only do, over his sad and melancholy death,—to that very death, with all the tragic circumstances that surround it, we would point as the closing sacrifice offered on the altar of our faith. His very intellect, his reason,—God's most precious gift,—a gift dearer than life,—perished in the great endeavour to harmonize the works and word of the Eternal. A most inscrutable event, that such an intellect should have been suffered to go to wreck through too eager a prosecution of such work. But amid the mystery, which we cannot penetrate, our love, and our veneration, and our gratitude, toward that so highly gifted and truly Christian man shall only grow the deeper because of the cloud and the whirlwind in which he has been borne off from our side."

The Late Dr. Kane.—At a late special meeting of the American Geographical Society in New York, the President, the Revd. Francis L. Hawks, D. D., paid the following beautiful tribute to the memory of the late much lamented Dr. Kane.

Gentlemen of the Society: It becomes my sad duty, as your presiding officer, to bring to your notice the removal, by death, of one of our most distinguished associates. Our friend, Dr. Kane, is no more. I knew him intimately, and the strong bond of our personal friendship, while he lived, prompts me to solicit your in-

dulgence if I depart from the formality of a more official announcement on this occasion, and render my brief and humble tribute to the worth of a man whom I greatly loved. In my observation of human nature it has seldom fallen to my lot to meet a fellow-being possessed of more striking excellences, or in whom there was a combination more rare of seemingly opposite qualities; in him, however, they were all harmoniously blended, and it was precisely this fact which made him to me an object of deep and affectionate interest. To a fine mind, inquiring and analytical, he added great industry; and what he deemed worthy of study at all he studied thoroughly. The range of his attainments, too, was varied, and he had roamed largely over the wide-spread field of physical science. Both varied and accurate as were his attainments, there was a beautiful simplicity and modesty so blended with them, that no one ever could suspect him of feeling his superiority in learning, over those with whom he mingled. He had not studied for ostentatious display, but for usefulness in his station. The strong trait in his character was his indomitable energy. In his small and feeble frame there was combined an iron will, a giant power of resolute purpose. Impulsive, ardent as he was by nature, one might have expected that his would be just the disposition to leap prematurely to conclusions; but a very slight acquaintance soon proved that such was not his habit of mind. Rarely have I seen so much of impulsive warmth blended with the soberness of patient, laborious inquiry, and sound practical judgment, as in him. Thus for instance, the strong conviction he had of the open Polar sea, which he lived long enough to discover, was founded on no hasty or happy guess. In conversations which he held with me on the probabilities of its existence, when our discussion turned entirely on scientific considerations, I found that he had reasoned out his conclusions by a chain of induction almost as strictly severe as mathematical demonstration; indeed, part of his process was mathematical. Before he sailed, he told me he was sure there was open water around the pole, and that if he lived to return he hoped to be able to tell me he had seen it. He no more proceeded on conjecture merely than did Columbus in his assertion of the existence of our hemisphere. But with these intellectual traits, and with great personal intrepidity, he had a gentleness of heart as tender as a woman's. There was an over-flowing kindliness in his soul which stirred up his benevolence to its lowest depths when he encountered human misery, whether of body or mind. He spared not

time, nor toil, nor money, to relieve it. I may not violate the sacred confidence of private friendship under any circumstances, and least of all when the grave has for a time sundered the ties which bound us as earthly friends together; but were it lawful to speak all I know on this point, both as his almoner and adviser, I could move your generous sensibilities even to tears, by stories of as pure, disinterested, liberal, self-sacrificing efforts for others, as any it has been my lot to meet with in the records of human benevolence. Alas! my countrymen, what is his early grave but a noble testimonial to his humanity? He is dead himself, because he would snatch others from death.

Another remarkable trait in his character, was the power he had of commanding and exercising an irresistable influence over men. You, Sir (Mr. H. Grinnell), can bear witness with me to this. You have seen him when, with gentle firmness, when love and resolution were both unmistakablypresent, and both marvellously blended—you have seen him encounter the unequivocal purpose of insubordination and rebellion in the person of the enraged, reckless and desperate seaman who refuses obedience, and who possessed a physical power that could have killed him with a blow. You have seen that light, frail frame, that, alas, now sleeps in death, approach with quick, firm step, and with no weapons but such as nature gives, he but fixes his keen eye on the offender, and the clear sound of his voice rings upon the ears, in no tone of passion or anger. He but talks, and there is some strange magic in his manner and his words; for presently the tears begin to roll down the rugged, sunburnt cheeks of the hardy seaman; he has humanized him by some mysterious power made up of love and reason mixed. Rebellion dies, and in its place is born a reverence and affection so deep, so devoted, that to the end of our dead friend's life, none love him better than the vanquished rebel.

These were some of his qualities as a man. Of what he has done in the cause of science, and of our chosen department in particular, there is but little need that I should speak. In a short career of but 35 years, he has left upon the times in which he lived his impress so indelibly stamped, that science numbers him with her martyrs, and will not let his memory die. He has told, too, so beautifully and modestly the story of his last suffering pilgrimage in her cause, and that of benevolence, that his remembrance will be kept green in the land of our fathers as well as in our own; for the English language is our common property, and that which is

registered in the literature of that tongue, I love to think, is destined to a long existence and wide diffusion on our globe. Had e done less in *science*, England would not forget him, for his benevolent heart led him to seek the relief of Englishmen, undismayed by the horrors and perils of an Arctic voyage; but what he accomplished in science secured to him the generous tribute of acknowledgment and admiration from England's scientific men. He received there the medal of our sister institution, the Royal Geographical Society, her highest tribute to eminent service in geographical discovery.

And as for ourselves, there is little danger that we shall forget him. He was a noble specimen of man, and he was our countryman. Letters may yield a graceful tribute to his worth in language fitted to her mournful theme; science may rear his monument, and tell the world she weeps over one of her most gifted sons, and this all right; but there is a more touching tribute to his memory than either of these:

> "*Affection* shall tenderly cherish his worth,
> And *memory* deeply engrave it,
> Not upon tablets of brass or stone.
> But *in those fond hearts where best 'twas known.*"

Mr. F. A. Concklin then offered the following preamble and resolutions;

This Society having been informed of the death of Elisha Kent Kane, and deeming it due alike to the memory of our deceased associate and to the Society, that his daring in the cause of humanity, and his achievements in science should be fitly commemorated, therefore, be it

Resolved, That in the death of Dr. Kane this Society mourns the loss of a member whose name is illustrious before the nation and throughout the civilized world; and whose fame, we would fain believe, will be as enduring as it is deserved, of one whose deeds enoble our race and shed the highest honor upon the land which gave him birth.

Resolved, That while we lament the to us untimely loss of our illustrious associate, we find consolation in the thought that his life was sufficiently prolonged to enable him to fill up the measure of his renown; and that his very youth but renders his great example the more eloquent to us and the more inspiring to posterity.

Resolved, That the Council be requested to make arrangements for the delivery, at some future day, of a suitable eulogy upon the life and character of Dr. Kane.

Resolved, That a copy of these resolutions, with the preamble, signed by the President and Recording Secretary, be transmitted to the family of the deceased, and that they be published.

These resolutions were ably seconded by Dr. King, Columbia College, and after other appropriate remarks by Dr. J. W. Francis and the Revd. J. P. Thompson, they were unanimously adopted.

Francois Arago.—I saw Arago, for the first time, in the winter of 1852 and '53, within the walls of the *Institut de France*. Shortly after my entrance, a paper was read by a member, on the Physical Geography of a portion of the interior of Africa; which, to me appeared to be a production possessing an unusual degree of merit. When concluded, an old man, seated at an elevated bench, arose, put a few questions to the writer and sat down. The answers given, were evidently not satisfactory, for the old man again rose, and so dissected the paper, bit by bit, dwelling, with emphasis, on what he considered to be objectionable, and hurrying rapidly over other portions, that I doubt not, the writer hardly recognized his own production when again pretented to him, for he sat down with sullenness, without attempting to reply. Another (on Organic Chemistry I believe) followed, when the same old man had some remarks to offer. A third paper was then read on Physical Astronomy, and a discussion ensued, attended with more heat and anger than would have graced, even a less dignified assemblage. The old man had laid down postulates which he now saw were interfered with, and the essayist supported *his* views with marked ability and no less warmth; but gradually the tide of opinion turned in favor of the critic. At a loss to know the name of one who thus "bestrode that little world like a Colossus," I turned to a gentleman seated near me, and asked him if he could tell me the name of the old man with gray hair, shaggy eye-brows and husky voice, who seemed to play with the other Academicians as anglers do with trout. Monsieur, replied he, with more astonishment in his looks than was quite consistent with Parisian *politesse*, *c'est* Napoleon de L'Academie, the well known *sobriquet* revealed to me, Arago. Had I left Paris without

again visiting the "*Institut*," my recollections of the Astronomer would have been different from what they are,—I would have thought of him as a surly, ill natured old man, who had spent so much of his time among other and colder planets, that all his humanity had been frozen out of him, leaving him the most pitiful of all beings—Un esprit sans cœur.

But I subsequently paid another visit, when Arago was then in his place of perpetual Secretary. The *Academie* had assembled to hear an *eloge* on his friend and co-laborer in Science, the Astronomer Leopold de Buch of Berlin, recently deceased. The old man's countenance presented a pleasing contrast to what it did on a former occasion, it was now calm and even sorrowful,—he arose and alluded, in truly eloquent and feeling terms, to the sad event which had deprived the scientific world of one of its brightest ornaments, and had thinned the ranks of their associates. No one present seemed to feel the force of his words more fully than Arago himself. His voice trembled, and his hand shook so as to agitate violently the paper which it held. I left the halls of the *Academie* that evening, with feelings of admiration and esteem, far higher than could have been produced by the display of talents however exalted.

W. H. H.

Proceedings of the Botanical Society of Montreal.

At a Meeting of the above Society, held on the 22nd day of February last, the following Circular (which has been published for transmission to Botanists and Botanical Societies) was read and approved of, its object being to enlist the sympathy and aid of Scientific men in the obtaining of a sum of money sufficient to raise a suitable monument to the memory of the late Frederick Pursh, the celebrated Botanist.

Montreal, Canada East, *January*, 1857.

" In the course of last Spring, the attention of the Botanical Society of Montreal was directed to the fact that Baron Pursh, the celebrated botanist, who died in this City in 1820, was interred in the Old Burying Ground on Papineau Road, without any Monument. The Society immediately felt its obligation to render tribute to so illustrious a name, and accordingly appointed a Committee to transfer the remains to a new lot in Mount

Royal Cemetery, purchased for that purpose, and to take steps to raise an adequate sum of money for the erection of a Monument to his memory.

The remains of Pursh now rest in the Mount Royal Cemetery, and the Committee take the liberty of soliciting the favor of your assistance in the efforts the Society is now making, to raise a suitable Monument over his grave.

The following are a few particulars which the Society is enabled to furnish, regarding his life and labours:—

Frederick Pursh was a German by birth and education. He pursued a successful course of study in Dresden, and acquired, at an early age, a taste for Science, and a peculiar fondness for Botanical and Horticultural pursuits. He contemplated with pleasure and admiration, the many beautiful and singular flowers —the fine shrubs and ornamental trees, that adorned the gardens and pleasure-grounds, and which were natural productions of North America. This excited in his mind a strong desire to visit the new Continent—to observe in their natural soil and climate these same plants, the study of which had already afforded him so much gratification, and to make such discoveries as circumstances might throw in his way. Accordingly in 1799, he embarked for the United States, where he at once commenced his researches as a scientific and practical Botanist. He devoted his time to the field, the forest and the glen, and enriched his own extensive collections by valuable additions from the Herbaria of the United States' Botanists, with whom he became acquainted. His labours, however, were not confined simply to the formation of an Herbarium. He rendered his researches of great value by introducing into the garden many beautiful herbs and shrubs, whose cultivation has since been greatly extended. Having thus laboured assiduously for a lengthened period of 12 years—during which time he discovered many new and rare plants, and ascertained the soil, situation and range of country in which each species was found—he proceeded to England with the intention of publishing his researches. The materials he now possessed, together with the information obtained from collections he consulted in England, formed the basis of his "Flora Americæ Septentrionalis," in 2 vol. —a work which immediately gave him a high position among men of science and learning, and secured to his name an authority on North American Botany, that will be always recognised.

The success of this publication, and the interest excited by his discoveries, induced him, under favorable auspices, further to prosecute his researches in the Canadas—a country possessing a wide field for Botanical investigations. He accordingly arrived in the Lower Province with the view of forming a complete Herbarium of Canadian plants, of ascertaining the natural resources of the soil, and improving the system of Horticulture. His labours, however, were not of long duration, and not without many drawbacks. After having Botanized a large portion of Eastern Canada, and made a considerable collection of Plants, (which were subsequently destroyed by fire) he died in Montreal, in July, 1820—so destitute of means, that the expenses of his burial, and other outlays, were defrayed by his friends.

Pursh possessed a happy temperament—a kind and generous disposition, and was a universal favorite among gardeners, whose interests he served by every means in his power.

The following is the inscription which was clearly preserved on the Tin Plate, attached to the Coffin containing his remains:—
"*FREDERICK PURSH, DIED* 11*th JULY,* 1820, *AGED* 46 *YEARS.*"

James Barnston, M. D.
George Shepherd. } *Committee.*

James Barnston, Esq., M.D., and George Shepherd, Esq., have been appointed a Committee to receive Subscriptions for the above object, and communications on the subject may be addressed to either of the above gentlemen: or to J. G. Barnston, Esq., Secy. of the Society, No. 40, Little St. James Street, Montreal.

J. W. DAWSON, President,
Botanical Society of Montreal."

After the ordinary business had been transacted, Principal Dawson, the President of the Society, read an interesting paper "On the Botanical affinities of the Fossils known as *Sternbergiœ*," of which the following is a short *résumé.*

The fossils of the genus *Sternbergiœ* present the appearance of stems of plants, marked by transverse wrinkles, and sometimes showing internal partitions or *septa*, corresponding to the external wrinkles. They are found in the Coal Formation on both sides of the Atlantic, and quite plentifully in the Upper Coal Measures of Nova Scotia. The author noticed the views published by Brogniart, Lindley, Dawes, Williamson and himself on these singular vegetable remains, and stated that Prof. Williamson has satisfac-

torily proved that some at least of the species are casts of the pith of trees of the pine family,—the *Coniferous* trees of the coal period having differed from our modern pines in possessing large medullary cylinders. He then described some interesting specimens from Nova Scotia, shewing the structure not only of the wood, but of the transverse septa, and remains of the external bark of the tree. He compared these specimens with recent woods shewing a similar modification of the pith, and stated some facts indicating that pith casts of this kind may have been furnished by other plants as well as conifers. He concluded by drawing attention to the circumstance, that in very many cases the only remains of large trees are these casts of the medullary cavities. Professor Dawson is preparing for publication his recent observations on this subject.

At a subsequent monthly meeting of the Society, held March 6th, a very interesting paper was read by the Rev. A. F. Kemp upon the "*Algæ* of the Bermudas," which was illustrated by numerous very beautiful and well-preserved specimens. This paper will appear in the next number of the journal.

(Signed,) J. G. BARNSTON,
Secretary.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF APRIL, 1857.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day	Barometer corrected and reduced to 32° F. (English inches.) 6 a. m.	2 p. m.	10 p. m.	Temperature of the Air. F. 6 a. m.	2 p. m.	10 p. m.	Tension of Aqueous Vapour. 6 a. m.	2 p. m.	10 p. m.	Humidity of the Atmosphere. 6 a. m.	2 p. m.	10 p. m.
1	29·365	29·443	29·641	37·9	26·5	12·6	·199	·129	·048	·43	·80	·87
2	745	862	047	3·1	25·2	16·1	·044	·102	·076	·80	·65	·63
3	158	056	29·896	14·4	38·0	25·6	·073	·149	·118	·68	·76	·73
4	738	703	864	24·9	51·0	39·2	·102	·255	·234	·65	·66	·89
5	730	535	471	29·8	51·1	51·6	·138	·315	·377	·74	·81	·87
6	211	224	213	56·0	48·1	31·0	·336	·312	·171	·88	·86	·89
7	494	696	922	21·2	32·1	25·9	·118	·160	·112	·88	·80	·70
8	986	765	864	31·3	37·1	40·0	·153	·199	·237	·78	·83	·86
9	860	848	518	36·4	42·1	35·0	·192	·243	·203	·33	·85	·90
10	483	814	765	32·0	39·1	36·0	·183	·220	·218	·90	·89	·94
11	538	534	710	35·0	44·6	37·2	·208	·211	·218	·91	·85	·91
12	680	657	722	35·8	53·0	39·4	·210	·299	·233	·91	·73	·89
13	785	804	799	32·1	53·5	41·6	·191	·293	·235	·94	·70	·85
14	642	358	28·982	32·7	36.2	37·0	·191	·229	·238	·93	·98	1·000
15	28·946	29·043	29·164	33·9	42·9	33·6	·204	·225	·187	·95	·79	·90
16	29.265	350	598	34·1	43·1	32·5	·178	·233	·182	·83	·79	·90
17	650	601	565	31·4	42·6	40·9	·171	·225	·235	·88	·79	·85
18	628	710	764	39·1	42·9	38·0	·214	·252	·227	·86	·85	·92
19	857	721	689	40·4	55·0	42·6	·227	·342	·261	·88	·76	·89
20	723	593	599	37·1	45·6	44·6	·199	·262	·283	·81	·81	·89
21	578	583	644	38·2	46·9	38·0	·207	·284	·194	·44	·42	·80
22	610	513	566	36.4	52·3	41·5	·192	·304	·201	·83	.76	·79
23	575	564	609	35·0	54·2	38·9	·186	·326	·179	·83	.76	·74
24	560	533	604	42·1	53·9	42·2	·242	·264	·199	·85	·61	·68
25	573	614	680	36·0	29·0	34·1	·192	·196	·162	·83	·76	·76
26	683	670	700	32·3	51·4	39·6	·167	·274	·193	·83	·70	·77
27	310	350	415	32·4	34·4	82·5	·160	·178	·191	·80	·83	·95
28	467	395	798	34·7	38·2	32·5	·195	·207	·178	·91	·84	·86
29	901	906	30·036	28·2	40.5	32.7	·135	·227	·174	·78	·75	·83
30	30·149	30·146	30·180	30·0	57.0	38.2	·160	·293	·177	·86	·76	·77

Day	Direction of Wind. 6 a. m.	2 p. m.	10 p. m.	Mean Velocity in Miles per hour. 6 a. m.	2 p. m.	10 p. m.	Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.] 6 a. m.	2 p. m.	10 p. m.
1	S. W. by W.	N. E. by N.	N. by E.	6·60	14·42	19·77	....	2·14	C. Str. 10.	Snow.	C. C. Str. 6.
2	W.	W. N. W.	N. by E.	15·77	8·33	17·40	....	....	Clear.	Clear.	Clear.
3	S.	S. S. W.	S. E. by E.	1·75	1·81	2·35	....	....	"	Str. 1.	Cirr. 4. Lunar Halo
4	S. S. E.	S. W.	S. S. W.	0·15	1·70	2·81	....	....	Cirr. Str. 6.	C. C. Str. 1.	Cirr. Str. 4. Lunar Halo
5	E. N. E.	S. E. by S.	S. S. E.	2·43	5·77	9.01	0·116	....	Cirr. Str. 10.	Nimb. 10.	Rain.
6	S. S. E.	S. S. E.	N. W.	24·82	12·20	12·53	0·795	1·20	C. C. Str. 10.	Rain.	Snow.
7	S. W.	S. W.	S. W.	14·37	16·23	11·10	....	1·50	Cirr. Str. 4.	Cirr. Str. 2.	Cirr. Str. 2.
8	S. E. by S.	S. E. by S.	S.	5·31	6·73	6·62	Inapp.	....	" 10.	" 10.	" 10.
9	S.	W. S. W.	W.	9·48	2·31	1·85	0·533	....	Rain.	" 10.	" 8.
10	N. N. E.	N. E.	N. E.	1·33	6·63	17·43	0·103	....	C. C. Str. 4.	" 6.	Rain.
11	W. N. W.	S. S. W.	S.	19·86	0·66	2·18	0·436	....	Cirr. Str. 10.	" 6.	Cirr. Str. 10.
12	W. S. W.	S.	S. by E.	4·20	2·12	1·76	....	....	" 4.	" 6.	" 4.
13	S.	E. by N.	S. E. by E.	0·12	0·40	1·67	....	....	Clear.	Cirr. 2.	" 6.
14	N. E. by E.	N. E. by E.	N. E.	3·90	20·86	29.31	3·196	....	Cirr. Str. 10.	Rain.	Rain.
15	S. W. by S.	W. S. W.	S. W.	9·07	13·66	9·11	0·850	0·40	" 10.	Cirr. Str. 10.	Clear Aurora Borealis.
16	W. S. W.	W. S. W.	S. W.	9·72	10·61	9·77	....	....	" 4.	" 2.	"
17	N. N. E.	N. E. by N.	N. N. W.	2·77	10·40	7·73	....	....	C. C. Str. 10.	" 8.	Cirr. Str. 8.
18	W. S. W.	N. E. by E.	N. E. by N.	7·41	8·83	1·37	....	....	" 9.	" 10.	C. C. Str. 4.
19	E. N. E.	S. E.	S. E. by S.	3·47	3·41	7·27	....	....	Clear.	" 9.	Cirr. Str. 10.
20	E. by S.	N. E. by N.	N. E. by N.	6·20	15·80	3·72	....	....	C. C. Str. 4.	" 10.	" 10.
21	N. E. by E.	N. E. by E.	E. N. E.	24·12	14.76	17·86	....	....	Cirr. Str. 4.	Cirr. Str. 1.	Clear.
22	N. E. by E.	N. E. by N.	N. E. by E.	10·15	9·92	5·60	....	....	Clear.	C. C. Str. 1.	Cirr. Str. 1.
23	N. N. E.	N. E. by E.	S. S. E.	4·01	0·63	1·92	Inapp.	....	Cirr. Str. 6.	Cir. Str. 10.	" 4.
24	E. S. E.	W. by S.	W. S. W.	6·22	8·00	16·92	....	....	Str. 2.	C. C. Str. 1.	" 2.
25	W. by N.	N. W.	W. by N.	4·01	10·39	3·43	....	....	C. Str. 1.	Cirr. Str. 8.	" 2.
26	W. by N.	W. by N.	S. E.	1·55	4·93	1·10	....	....	Clear.	Cum. 1.	Clear.
27	S. E.	S. E. by S.	E. by N.	1·92	4·57	0·05	0·710	1·70	C. Str. 10.	Rain.	Snow.
28	W. by N.	W.	W.	12·26	19·55	18.12	....	....	" 9.	Cir. Str. 8.	C. Str. 10.
29	W. N. W.	N. W.	N. N. W.	9·40	12·35	6·75	....	....	Clear.	" 1.	Clear.
30	N. E. by E.	W. S. W.	S. E.	0·02	0·12	6·30	....	....	"	Clear.	"

REPORT FOR THE MONTH OF MAY, 1857.

Day	Barometer 6 a. m.	2 p. m.	10 p. m.	Temperature 6 a. m.	2 p. m.	10 p. m.	Tension 6 a. m.	2 p. m.	10 p. m.	Humidity 6 a. m.	2 p. m.	10 p. m.
1	0·018	29·857	29·817	40·4	58·2	51·1	·227	·290	·238	·85	·59	·61
2	·804	568	512	40·7	48·8	47·2	·235	·336	·349	·84	·93	·98
3	784	787	854	40·1	48·0	39·8	·245	·266	·234	·85	·78	·91
4	866	785	751	36·0	54·6	46·9	·220	·349	·291	·94	·81	·85
5	600	489	518	40·9	39·3	36·1	·255	·245	·217	·94	·96	·98
6	595	650	692	34·5	42·2	40·5	·214	·243	·245	·99	·85	·92
7	717	741	847	41·1	48·5	41.2	·253	·324	·253	·91	·92	·91
8	899	907	982	38·5	60·4	50.4	·226	·350	·283	·90	·66	·75
9	779	612	496	47·4	80·0	62·0	·252	·481	·397	·76	·47	·71
10	524	350	593	55·0	28·5	39·0	·399	·346	·214	·89	·70	·84
11	40	800	914	30·1	44·0	35·0	·145	·223	·170	·78	·73	·76
12	994	932	910	29·7	54·1	40·6	·152	·326	·194	·82	·76	·78
13	856	801	819	38·6	59·5	46.6	·189	·267	·210	·76	·52	·64
14	780	612	570	44·1	66·0	47·6	·223	·394	·271	·73	·61	·80
15	506	465	510	42.0	54·6	46·7	·152	·199	·282	·73	·46	·86
16	563	588	670	40·1	63·6	47·0	·194	·326	·271	·73	·56	·80
17	696	795	899	42·2	42·4	41·6	·252	·243	·249	·85	·85	·86
18	947	881	916	40·5	66·8	50·9	·210	·416	·285	·79	·65	·75
19	926	861	842	40·3	58·0	45·0	·153	·243	·202	·57	·49	·64
20	776	715	678	43·3	56·9	47·0	·216	·255	·252	·73	·55	·75
21	599	574	579	46·1	62·4	56·8	·262	·375	·305	·80	·67	·66
22	588	564	896	50·0	78·5	65·8	·326	·473	·366	·86	·50	·63
23	560	527	596	52.5	80·9	62·4	·304	·473	·397	·76	·46	·71
24	659	621	606	59·4	86·1	64·0	·283	·552	·425	·72	·43	·71
25	572	488	523	64·0	87·0	70·5	·476	·607	·489	·78	·48	·67
26	793	840	797	47·3	65·5	55·4	·271	·473	·312	·80	·74	·81
27	641	530	501	62·0	79·8	67·0	·451	·568	·408	·76	·58	·61
28	555	424	469	51·5	77·5	55·1	·379	·588	·394	·93	·64	·88
29	418	384	429	57·0	67·8	56·0	·432	·534	·385	·90	·81	·84
30	528	567	662	50·3	59.1	50·1	·326	·426	·326	·87	·84	·87
31	675	633	663	50·0	72·0	54.2	·304	·498	·373	·80	·64	·87

Day	Wind 6 a. m.	2 p. m.	10 p. m.	Velocity 6 a. m.	2 p. m.	10 p. m.	Rain	Snow	Weather 6 a. m.	2 p. m.	10 p. m.
1	S. E. by S.	S. by E.	S. by E.	0·00	16·02	9·25	....	....	C. C. Str. 4.	Cum. Str. 8.	Nimb. 10.
2	S. by E.	S. by E.	S.	9·22	4·50	2·90	0·343	....	Rain.	Rain.	Cum. Str. 10.
3	W.	W. by N.	S. W.	6·82	4·60	5·30	....	....	Cirr. Str. 9.	Cirr. Str. 6.	Clear Aurora Borealis.
4	S. by E.	N. E. by E.	N. E. by E.	1·55	3·40	1·21	....	....	" 6.	" 8.	Rain.
5	N. E. by E.	N. E. by E.	N. E. by E.	21·11	31·85	21·57	1·336	....	Rain.	Rain.	Rain.
6	N. E. by E.	N. W.	S. S. W.	5·93	0·20	0·01	0·686	....	Cirr. Str. 10.	Cirr. Str. 10.	Cirr. Str. 9.
7	S. W. by S.	S. W.	W. S. W.	0·35	3·65	2·80	0·014	....	Rain.	" 2.	Clear.
8	S. W. by N.	N. W.	S. by W.	1·30	8·71	4·65	....	....	Clear.	Clear.	"
9	S. by E.	S. W.	S. by E.	0·76	4·76	7·05	....	....	C. C. Str. 1.	Cum. Str. 4.	Str. 2.
10	S. S. W.	S. W.	N. W. by N.	6·05	9·15	10·70	0·009	....	Cum. Str. 8.	" 9.	Rain.
11	N.	N. E. by N.	N. E.	24·41	4·00	2·28	....	....	Clear.	Clear.	Clear.
12	S. W. by N.	W. by S.	W. by S.	2·12	1·65	4·10	....	....	"	"	Str. 2.
13	S. W.	N. W. by W.	S.	4·00	3·97	7·81	....	....	"	Cum. Str. 6.	Clear Aurora Borealis.
14	N. N. E.	N. E. by E.	S. S. E.	0·41	0·52	1·35	....	....		Clear.	C. Str. 8.
15	N. E. by E.	N. E. by E.	S.	11·52	4·60	0·92	....	....	C. Str. 10.	Cirr. Str. 10.	" 10.
16	N. E. by N.	E. S. E.	S. by E.	0·90	3·93	0·16	....	....	Cirr. C. Str. 8.	Hazy.	" 10.
17	S. by E.	W. by N.	S. W.	3.03	9·30	1·20	0·663	....	Rain.	Rain.	Clear.
18	W. by N.	S. S. W.	W.	11·46	2·85	0·40	....	....	Clear.	C. Str. 4.	Cirr. C. Str. 4.
19	E. N. E.	E. N. E.	E. N. E.	5·61	12·67	11·85	....	....	Clear Frost.	Str. 2.	Str. 2.
20	E. N. E.	E.	W. by S.	15·81	6·92	1·42	....	....	"	Cirr. Str. 9.	Cirr. C. Str. 9.
21	S. W.	W. N. W.	W. N. W.	2·80	2·77	6·75	....	....	C. C. Str. 6.	" 4.	Clear.
22	S.	S. S. E.	S. W. by W.	0·00	1·15	2·21	....	....	Clear.	C. Cum. Str. 4.	Cirr. Str. 9.
23	S. S. W.	S. S. W.	S. W. by S.	0·45	1·47	2·86	....	....	"	Clear.	Clear.
24	W. S. W.	S. W. by S.	S.	0·91	1·21	2·36	....	....		"	Hazy.
25	S. W. by S.	W. by S.	S. W. by W.	1·92	6·46	8·90	....	....	C. Str. 4.	Hazy.	Hazy.
26	N. by E.	N. by E.	N. N. E.	11·65	21·25	2·20	Inapp.	....	Clear.	Clear.	Cir. Str. 10.
27	N. E.	S. E.	S. E.	7·05	2·96	12·97	0·100	....	C. Str. 6.	C. Str. 4.	" 4. Ra. with Th.
28	S. E.	E. S. E.	S. W.	5·05	1·11	4·05	1·434	....	Rain.	" 6.	" 8. Thunder.
29	S. W. by W.	S. S. W.	S. W. by W.	0·22	8·18	11·06	....	....	C. Str. 4.	" 2.	Str. 2.
30	W. S. W.	W. S. W.	S. S. W.	12·10	10·92	2·57	....	....	" 4.	C. C. Str. 8.	Clear.
31	S. S. W.	S. W.	S. S. E.	0·12	0·92	2·01	....	....	C. C. Str. 4.	" 4.	C. C. Str. 4. Lunar Halo.

REMARKS FOR APRIL, 1857.

Barometer. Highest, the 30th day, 30·180 inches.
Lowest, the 15th day, 28·916 "
Monthly Mean, 29·691 inches.
Monthly Range, 1·134. "

Thermometer. Highest, the 13th day, 55°7.
Lowest, the 2nd day, 2°9.
Monthly Mean, 37°19.
Monthly Range, 52°8.

Greatest intensity of the Sun's rays, 98°6.
Lowest point of Terrestrial radiation, 1°4.
Mean of Humidity, ·821.
Amount of Evaporation, 1·75 inches.
Rain fell on 10 days amounting to 6·549 inches; it was raining 61 hours 46 minutes.

Snow fell on 5 days amounting to 6·94 inches; it was snowing 26 hours 20 minutes.
The most prevalent wind was the N. E. by E. The least prevalent wind was the E by S.
The most windy day was the 21st day; mean miles per hour, 18·91.
Least windy day, the 15th day; miles per hour, 0·73.
Lunar Halo visible on 2 nights.
Aurora Borealis visible on the 1st night.
Swallows 1st seen on the 19th day.
Frogs 1st heard on the 22nd day.
The Electrical state of the atmosphere has indicated moderate intensity.
Ozone was in large quantity.

REMARKS FOR MAY, 1857.

Barometer. Highest, the 1st day, 30·018 inches.
Lowest, the 10th day, 29·324 "
Monthly Mean, 29·982 inches.
Monthly Range, 0·694 "

Thermometer. Highest, the 24th day, 88°5.
Lowest, the 12th day, —26°9.
Monthly Mean, 51°90.
Monthly Range, 61°6.

Greatest intensity of the Sun's rays, 122°4.
Lowest point of Terrestrial radiation, —24°7.
Mean of Humidity, ·753.
Amount Evaporation 3·010 inches.

Rain fell on 3 days amounting to 4·262 inches; it was raining 68 hours 42 minutes and was accompanied by Thunder on 2 days.
Most prevalent wind the N. E. by E. Least prevalent wind the E.
Most windy day, the 5th day; mean miles per hour, 24·84.
Least windy day, the 31st day; mean miles per hour, 0·71.
Aurora Borealis was visible on 2 nights.
Lunar Halo on 1 night.
The Electrical state of the atmosphere has indicated moderate intensity.
Ozone was in moderate quantity.
Shad 1st caught on the 24th day.

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ART. IX.—*The Testimony of the Rocks.* By HUGH MILLER.

This work comes to us with the melancholy interest which always attaches to the last thoughts of a great man, and especially to those thoughts which by their consuming intensity, have aided in wearing to the death the frail tenement in which a gifted soul did its earthly work. In reading this book, so full of lofty faith and true sympathy with God, with nature, and with man, the sad end of its author ever recurs to us like a hideous dream which cannot be true; and we feel more forcibly impressed on our minds the suspicion arising from many minute but important circumstances, that we do not yet know the real manner of Hugh Miller's death; and that the vulgar explanation of suicide under mental aberration, is but the thought of common minds, seeking a common solution for a strange and almost unaccountable event. Hugh Miller as we remember him, calm, thoughtful, and self-possessed, yet full of quiet enthusiasm, is the writer of this book but not the subject of the coroner's verdict; and though we must

admit that his brain, irritated by over work, had become a prey to undue excitement and groundless fears,—we shall suspend our judgment on the question of accidental death or suicide, until we meet our friend again in that world where he now enjoys an emancipation from his earthly toils and frailties.

The subject of this work was one on which its author thought deeply and often; and few men were better fitted for it by the rare combination of acute powers of observation applied to nature, and firm faith in revealed religion. The question of the relations of the Bible to science, and especially to the science of the earth, is not one which either naturalists or theologians can afford to neglect. Those who have no settled faith in the inspiration of the written word may smile at any attempt to compare it with the deductions of science. Those who do not appreciate the mass of evidence accumulated by modern geology, may sneer at what appears to them an upstart and unsettled jumble of hypotheses. Nevertheless, it is morally certain that the Bible must maintain a constantly increasing ascendancy over the minds of men, and that they must accept it as a revelation of God, as the Creator as well as the Redeemer. On the other hand the leading principles of geology rest on a basis of facts, firm as the everlasting hills, and their popular acceptance is daily widening. The Testimony of the Rocks, in its bearing on the natural and revealed theologies, must therefore form a department of inquiry running parallel with the acceptance among civilized men of that testimony and of those theologies.

The Testimony of the Rocks is not a systematic treatise, but a collection of lectures, yet the writer's strong love of order has thrown the matter into an arrangement which brings out very forcibly and lucidly his two leading views. First, that there has been throughout the long periods of geological history, a constant and regular onward march of new forms of existence, corresponding with the received views of the relative rank of organization of animals and plants, yet not proceeding from spontaneous development, but from creation. Secondly, that the introduction of new forms of animals and plants corresponded with the days or rather long "eons" represented by the Mosaic vision of creation. The first lecture accordingly contains a connected sketch of the history of plants, from the old fucoids of the Silurian seas, and the huge cryptogams and antique conifers of the Devonian and Carboniferous erus, to the more varied vegetation of the modern

period, retaining the leading types of the old forms, but giving them a much lower relative position. The succession of plants is well and powerfully sketched, especially in the singular parallelism between the historical succession and the botanical arrangement; and its bearing on natural theology is thus stated.

"Let us then, in grappling with the vast multiplicity of our subject, attempt reducing and simplifying it by means of the classifying principle, not simply, however,—again to recur to the remark of the metaphysician,—as an internal principle given us by nature, but as an external principle *exemplified* by nature. Let us take the organisms of the old geologic periods in the order in which they occur in time; secure, as has been shown, that if our chronology be correct, our classification will, as a consequence, be good. It will be for the natural theologians of the coming age to show the bearing of this wonderful fact on the progress of man towards the just and the solid, and on the being and character of man's Creator,—to establish, on the one hand, against the undue depreciators of intellect and its results, that in certain departments of mind, such as that which deals with the arrangement and development of the scheme of organic being, human thought is not profitlessly revolving in an idle circle, but progressing Godwards, and gradually unlocking the order of creation. And, on the other hand, it will be equally his proper business to demand of the Pantheist how,—seeing that only *persons* (such as the Cuviers and Lindleys) could have wrought out for themselves the real arrangement of this scheme,—how, I say, or on what principle, it is to be held that it was a scheme originated and established at the beginning, not by a *personal*, but by an *im*personal God. But our present business is with the *fact* of the parallel arrangements, Divine and human,—not with the inferences legitimately deducible from it."

The second lecture takes a similar view of the history of animals, with the same result, even more strikingly exhibited, in consequence of the greater completeness of our knowledge of fossil zoology. This part of the subject affords an admirable field for the descriptive powers of the author, and he makes creation proceed before us in a series of magnificent pictures, which, as he well says, surpass in interest the historic revelations of Egyptian obelisks and Assyrian friezes.

Then follows the well-known lecture delivered before the Young Men's Christian Association of London, which was at the time the

best popular summary of that theory of day-periods which is likely now to be the currently received mode of reconciling Scripture with geology. In the present work this lecture is followed up by another view, recently added to the former, and though in a somewhat different aspect, long familiar to the minds of expositors, that of the optical representation of creation to Moses, in a series of days representative of periods. As this is a comparatively unfamiliar view, we give the author's closing summary.

"Such a description of the creative vision of Moses as the one given by Milton of that vision of the future, which he represents as conjured up before Adam by the archangel, would be a task rather for the scientific poet than for the mere practical geologist or sober theologian. Let us suppose that it took place far from man in an untrodden recess of the Midian desert, ere yet the vision of the burning bush had been vouchsafed; and that, as in the vision of St. John in Patmos, voices were mingled with scenes, and the ear as certainly addressed as the eye. A "great darkness" first falls upon the prophet, like that which in an earlier age fell upon Abraham, but without the "horror;" and, as the Divine Spirit moves on the face of the wildly troubled waters, as a visible aurora enveloped by the pitchy cloud, the great doctrine is orally enunciated, that "in the beginning God created the heavens and the earth." Unreckoned ages, condensed in the vision into a few brief moments, pass away; the creative voice is again heard,—"Let there be light," and straightway a gray diffused light springs up in the east, and casting its sickly gleam over a cloud-limited expanse of steaming, vaporous sea, journeys through the heavens towards the west. One heavy, sunless day is made the representative of myriads; the faint light waxes fainter,—it sinks beneath the dim, undefined horizon; the first scene of the drama closes upon the seer; and he sits awhile on his hill-top in darknes, solitary but not sad, in what seems to be a calm and starless night.

"The light again brightens,—it is day; and over an expanse of ocean without visible bound the horizon has become wider and sharper of outline than before. There is life in that great sea,—invertebrate, mayhap also ichthyic, life; but, from the comparative distance of the point of view occupied by the prophet, only the slow roll of its waves can be discerned, as they rise and fall in long undulations before a gentle gale; and what most strongly impresses the eye is the change which has taken place in the atmospheric sce-

nery. That lower stratum of the heavens occupied in the previous vision by seething steam, or gray, smoke-like fog, is clear and transparent; and only in an upper region, where the previously invisible vapor of the tepid sea has thickened in the cold, do the clouds appear. But there, in the higher strata of the atmosphere they lie, thick and manifold,—an upper sea of great waves, separated from those beneath by the transparent firmanent, and like them too, impelled in rolling masses by the wind. A mighty advance has taken place in creation; but its most conspicuous optical sign is the existence of a transparent atmosphere,—of a firmanent stretched out over the earth, that separates the waters above from the waters below. But darkness descends for the third time upon the seer, for the evening and the morning have completed the second day.

"Yet again the light rises under a canopy of cloud; but the scene has changed, and there is no longer an unbroken expanse of sea. The white surf breaks at the distant horizon, on an isulated reef, formed mayhap by the Silurian or Old Red coral zoophytes ages before, during the bygone yesterday; and beats in long lines of foam, nearer at hand, against a low, winding shore, the seaward barrier of a widely spread country. For at the Divine command the land has arisen from the deep,—not inconspicuously and in scattered islets, as at an earlier time, but in extensive though flat and marshy continents, little raised over the sea level; and a yet further fiat has covered them with the great carboniferous flora. The scene is one of mighty forests of cone-bearing trees,—of palms, and tree-fern, and gigantic club mosses, on the opener slopes, and of great reeds clustering by the sides of quiet lakes and dark rolling rivers. There is deep gloom in the recesses of the thicker woods, and low thick mists creep along the dank marsh or sluggish stream. But there is a general lightening of the sky over head; as the day declines, a redder flush than had hitherto lighted up the prospect falls athwart fern covered bank and long withdrawing glade. And while the fourth evening has fallen on the prophet, he becomes sensible, as it wears on, and the fourth dawn approaches, that yet another change has taken place. The Créator has spoken, and the stars look out from openings of deep unclouded blue; and as day rises, and the planet of morning pales in the east, the broken cloudlets are transmuted from bronze into gold, and anon the gold becomes fire, and at length the glorious sun arises out of the sea, and enters on his course rejoicing. It

is a brilliant day; the waves, of a deeper and softer blue than before, dance and sparkle in the light; the earth, with little else to attract the gaze, has assumed a garb of brighter green; and as the sun declines amid even richer glories than those which had encircled his rising, the moon appears full orbed in the east,—to the human eye the second great luminary of the heavens,—and climbs slowly to the zenith as night advances, shedding its mild radiance on land and sea.

"Again the day breaks; the prospect consists, as before, of land and ocean. There are great pine woods, reed-covered swamps, wide plains, winding rivers, and broad lakes; and a bright sun shines over all. But the landscape derives its interest and novelty from a feature unmarked before. Gigantic birds stalk along the sands, or wade far into the water in quest of their ichthyic food; while birds of lesser size float upon the lakes, or scream discordant in hovering flocks, thick as insects in the calm of a summer evening, over the narrower seas, or brighten with the sunlit gleam of their wings the thick woods. And ocean has its monsters: great "*tanninim*" tempest the deep, as they heave their huge bulk over the surface, to inhale the life-sustaining air; and out of their nostrils goeth smoke, as out of a "seething pot or cauldron." Monstrous creatures, armed in massive scales, haunt the rivers, or scour the flat rank meadows; earth, air, and water are charged with animal life; and the sun sets on a busy scene, in which unerring instinct pursues unremittingly its few simple ends,—the support and preservation of the individual, the propagation of the species, and the protection and maintenance of the young.

"Again the night descends, for the fifth day has closed; and morning breaks on the sixth and last day of creation. Cattle and beasts of the fields graze on the plains; the thick skinned rhinoceros wallows in the marshes; the squat hippopotamus rustles among the reeds, or plunges sullenly into the river; great herds of elephants seek their food amid the young herbage of the woods; while animals of fiercer nature, the lion, the leopard, and the bear,—harbor in deep caves till the evening, or lie in wait for their prey amid tangled thickets, or beneath some broken bank. At length, as the day wanes and the shadows lengthen, man, the responsible lord of creation, formed in God's own image, is introduced upon the scene, and the work of creation ceases forever upon the earth. The night falls once more upon the prospect, and there dawns yet another morrow,—the morrow of God's rest,

—that Divine Sabbath in which there is no more creative labor, and which, "blessed and sanctified" beyond all the days that had gone before, has as its special object the moral elevation and final redemption of man. And over *it* no evening is represented in the record as falling, for its special work is not yet complete. Such seems to have been the sublime panorama of creation exhibited in vision of old to

> "The shepherd who first taught the chosen seed,
> In the beginning how the heavens and earth
> Rose out of chaos;"

and, rightly understood, I know not a single scientific truth that militates against even the minutest or least prominent of its details."

In its details we believe that this view will admit of some modification, but we may accept the principle as the best guide to the reconciliation of the two documents in the present state of knowledge. The two following lectures pursue this principle of explanation into details, with many interesting and beautifully sketched illustrations. The next subject is the Noachian deluge, which the author with most modern interpreters, and believes to have been universal, only in so far as relates to man and the region he then inhabited. Rising again to general views, we have in the ninth lecture a sketch of the relations that in past and darker ages have obtained between imperfect views of religion and creation, and equally imperfect information on the system of nature. This naturally leads to an investigation of the errors still widely prevalent, that result from such half truths and biassed reasonings; and we have much sharp criticism of the rationalistic expositors who regard Genesis as a myth, and the unreasonable anti-geologists who refuse to accept the Testimony of the Rocks.

Having thus far restricted himself to a somewhat orderly investigation of his more immediate subject, the author desirous of giving to his work that scientifie originality which in these days of progress can alone attract the working naturalist, adds in an expanded form the interesting paper on the less known fossil floras of Scotland, read by him before the British Association in 1855. Though not strictly a sequel to the previous subject, this paper forms a practical illustration of the succession of fossil floras, just as in the Footprints of the Creator, the Asterolepis and its allies, are the text of that noble specimen of natural theology. The geologist inter-

ested in fossil botany will find in this part of the work a collection of valuable facts which have hitherto been singularly neglected by Scottish geologists. The following extract gives a summary of the oldest fossil land plants of Scotland, which there as in Ireland and in America, occur unequivocally for the first time in the Devonian series.

"The remains of a terrestrial vegetation in this deposit are greatly scantier than those of its marine plants; but they must be regarded as possessing a peculiar interest, as, with the exception of the spore cases of the Ludlow rocks, the oldest of their class, in at least the British islands, whose true place in the scale can be satisfactorily established. In the flagstones of Orkney there occurs, though very rarely, a minute vegetable organism, which I have elsewhere described as having much the appearance of one of our smaller ferns, such as the maidenhair-spleenwort, or dwarf moonwort. It consists of a minute stem, partially covered by what seems to be a small sheath or hollow bract, and bifurcates into two fronds or pinnæ, fringed by from ten to twelve leaflets, that nearly impinge on each other, and somewhat resemble in their mode of arrangement the leaflets of one of our commonest Aspleniums,—*Asplenium trichomanes.* One of our highest authorities, however, in such matters (Professor Balfour of Edinburgh) questions whether this organism be in reality a fern, and describes it from the specimen on the table, in the Palæontological chapter of his admirable Class-Book, simply as "a remarkable pinnate frond." (Fig. 13, p. 56.) We find it associated with the remains of a terrestrial plant allied to lepidodrendon, and which in size and general appearance not a little resembles one of our commonest club mosses,—*Lycopodium clavatum.** It sends out its branches in exactly the same style,—some short and simple, others branched like the parent stem, in an arrangement approx-

* I figured this species from an imperfect Cromarty specimen fifteen years ago. (See "Old Red Sandstone," first edition, 1841, Plate VII. Fig. 4.) Of the greatly better specimens now figured I owe the larger one (Fig. 120) to Mrs. Mill, Thurso, who detected it in the richly fossiliferous flagstones of the locality in which she resides, and kindly made it over to me; and the specimen of which I have given a magnificent representation (Fig. 12, p, 55) to my friend Mr. Robert Dick. I have, besides, seen several specimens of the same organism, in a better or worse state of keeping, in the interesting collection of the Rev. Charles Clouston, Sandwick, near Stromness.

imately alternate; and is everywhere covered, stem and branch, by thickly set scale-like leaflets, that, suddenly narrowing, terminate in exceedingly slim points. It has, however, proportionally a stouter stem than Lycopodium; its leaves, when seen in profile, seem more rectilinear and thin; and none of its branches yet found bear the fructiferous stalk or spike. Its resemblance, however, to this commonest of the Lycopodia,—a plant that may be gathered by handfuls on the moors by which the flagstone are covered,—is close enough to suggest a new reading of the familiar adage on the meeting of extremes. Between the times of this ancient fossil,—one of the oldest of land plants yet known,—and those of the existing club moss that now scatters its light spores by millions over the dead and blackened remains of its remote predecessor, many creations must have intervened, and many a prodigy of the vegetable world appeared, especially in the earlier and middle periods,—Sigillaria, Favularia, Knorria, and Ulodendron,—that have had no representatives in the floras of latter times; and yet here, flanking the immense scale at both its ends, do we find plants of so nearly the same form and type, that it demands a careful survey to distinguish their points of difference. Here, for instance, to illustrate the fact, is there a specimen of *Lycopodium clavatum*, from one of these Caithness moors, that agrees branch for branch, and both in the disposition of its scales and in general outline, with the specimen in the stone. What seems to be an early representative of the Calamites occurs in the same beds. Some of the specimens are of large size,—at least from nine inches to a foot in circumference,—and retain their thickness, though existing as fragments several feet in length, with but little diminution throughout. They resembled the interior casts of Calamites in being longitudinally furrowed; but the furrows are flatter, and are themselves minutely striated lengthwise by lines as fine as hairs; and, instead of presenting any appearance of joint, there run diagonally across the stems, interrupted and very irregular lines of knobs. These I find referred to by Dr. Joseph Hooker, in describing a set of massive but ill preserved remains of the same organism detected in South Ness quarry, near Lerwick, by the Hon. Mr. Tuffnell, as taking, in two of the specimens, "the appearance of transverse knobs and bars (mayhap spirally arranged) that cross the striæ obliquely. But though the knobs," he adds, "may perhaps indicate a peculiar character of the plants, they have more probably been caused by pres-

sure during silicification." As, however, they also occur in the best preserved fragment of the plant which I have yet seen,—a Thurso specimen which I owe to my friend Mr. Dick,—I deem it best to regard them, provisionally at least, as one of the characteristics of the plant. I may mention, that while I disinterred one of my specimens from the Thurso flagstones, where it occurred among remains of Dipterus and Asterolepis, I derived another specimen from the great overlying formation of pale Red Sandstone to which the lofty hills of Hoy and the tall mural precipices of Dunnet Head belong; and that this plant is the only organism which has yet been found in this uppermost member of the Lower Old Red, to at least the north of the Moray Frith. Another apparently terrestrial organism of the lower formation, of, however, rare occurrence, very much resembles a sheathing bract or spathe. It is of considerable size,—from four to six inches in length, by from two to three inches in breadth,—of a broadly elliptical and yet somewhat lanceolate form, deeply but irregularly corrugated, the rugæ exhibiting a tendency to converge towards both its lower and upper terminations, and with, in some instances, what seems to be the fragment of a second spathe springing from its base. Another and much smaller vegetable organism of the same beds presents the form of a spathe-enveloped bud or unblown flower wrapped up in its calyx; but all the specimens which I have yet seen are too obscure to admit of certain determination. I may here mention, that curious markings, which have been regarded as impressions made by vegetables that had themselves disappeared, have been detected during the last twelvemonth in a quarry of the Lower Old Red Sandstone near Huntly, by the Rev. Mr. Mackay of Rhynie. They are very curious and very puzzling; but though some of the specimens present the appearance of a continuous midrib, that throws off, with a certain degree of regularity, apparent leaflets, I am inclined to regard them rather as lying within the province of the ichnologist than of the fossil botanist. They bear the same sort of resemblance to a long, thickly-leaved frond, like that of the "hard fern," that the cast of a many-legged annelid does to a club moss; and I was struck, on my first walk along the Portobello beach, after examining a specimen kindly sent me by Mr. Mackay, to see how nearly the tract of a small shore crab (*Carcinus Mœnas*) along the wet sand resembled them, in exhibiting what seemed to be an obscure midrib fringed with leaflets.

"But the genuine vegetable organism of the formation, indicative of the highest rank of any yet found in it, is a true wood of the cone-bearing order. I laid open the nodule which contains this specimen, in one of the ichthyolite beds of Cromarty, rather more than eighteen years ago; but though I described it, in the first edition of my little work on the Old Red Sandstone, in 1841, as exhibiting the woody fibre, it was not until 1845 that, with the assistance of the optical lapidary, I subjected its structure to the test of the microscope. It turned out, as I had anticipated, to be the portion of a tree; and on my submitting the prepared specimen to one of our highest authorities,—the late Mr. William Nicol,—he at once decided that the "reticulated texture of the transverse section, though somewhat compressed, clearly indicated a coniferous origin." I may add, that this most ancient of Scottish lignites presents several peculiarities of structure. Like some of the Araucarians of the warmer latitudes, it exhibits no lines of yearly growth; its medullary rays are slender, and comparatively inconspicuous; and the discs which mottle the sides of its sap-chambers, when viewed in the longitudinal section, are exceedingly minute, and are ranged, so far as can be judged in their imperfect state of keeping, in the alternate order peculiar to the Araucarians. On what perished land of the early Palæozoic ages did this venerably antique tree cast root and flourish, when the extinct genera Pterichthys and Coccosteus were enjoying life by millions in the surrounding seas, long ere the flora or fauna of the Coal Measures had begun to be?

"I may be here permitted to mention, that in a little volume, written in reply to a widely known and very ingenious work on the Development hypothesis, I described and figured this unequivocally genuine lignite, in order to show that a true wood takes its place among the earliest terrestrial plants known to the geologist. I at the same time mentioned,—desirous, of course, that the facts of the question should be fairly stated, whatever their bearing,—that the nodule in which it occurred had been partially washed out of the fish-bed in which I found it, by the action of the surf; and my opponent, fixing on the circumstance, insinuated, in the answer with which he honored me, that it had *not* belonged to the bed at all, but had been derived from some other formation of later date. He ought, however, to have taken into account my further statement, namely, that the same nodule which enclosed the lignite contained part of another fossil, the well-marked scales

of *Diplacanthus striatus*, an ichthyolite restricted, like the Coccosteus (a specimen of which occurred in a neighboring nodule,) to the Lower Old Red Sandstone exclusively. If there be any value whatever in palæontological evidence, this Cromarty lignite must have been deposited in a sea inhabited by the Coccosteus and Diplacanthus. It is demonstrable that, while yet in the recent state, a Diplacanthus lay down and died beside it; and the evidence in the case is unequivocally this, that in the oldest portion of the oldest terrestrial flora yet known, there occurs the fragment of a tree quite as high in the scale as the stately Norfolk Island Pine, or the noble cedar of Lebanon."

J. W. D.

ARTICLE X.—*Notes on the Natural History of the Mountain of Montreal,*

1. *The Ruffed Grouse (Tetrao Umbellus) breeds upon the mountain.*—While taking a walk a few days since, I was somewhat surprised to hear distinctly the drumming of a grouse in the wood on the back part of the mountain, overlooking the Cemetry. I only heard the closing notes, but, being quite familiar with the sounds, was well satisfied that they proceeded from a bird of this species. Turning soon afterwards to cross towards the city, I had ample confirmation of my suspicions. Another grouse had been started on that side by two yonng men who were climbing up the hill. The bird alighted within a few yards of the spot where I was standing, but again took wing immediately upon seeing me. It remained, however, long enough for me to observe that it was a fine large male. It was certainly a different bird from the former, and accordingly there were on that day, at least, two males on the mountain; and further, as it is quite probable that they have their consorts, no doubt, they will breed there, if not killed by some of the sportsmen who frequent that locality.

Mentioniug the above circumstances afterwards to a friend, he informed me that he believed grouse were always to be found on the mountain. If so, it is a remarkable fact. The habits of this species are not those of an open country bird. The little patch of wood which covers the hill actually extends into the suburbs of the city, and it is not only isolated from the main body of the forest by many miles in width of cultivated land, but it is also

traversed every day in all directions by scores of enthusiastic young Nimrods, who fire at everything that happens to be clothed with feathers, no matter how small. It is wonderful that so conspicuous a bird as a ruffed grouse could remain there a single week without being killed, and yet, there is reason to believe, that the species has maintained its ground in this spot since the days when the red men were masters of the island.

2. *A rare English Butterfly, common.*—Near McTavish's Monument I started a very beautiful butterfly, but after much tantalizing effort had the melancholy satisfaction of seeing it soar away out of sight. Not being an entomologist, it is quite probable that I did not adopt the proper method to ensure success. Ascending to the brow of the mountain, I saw another evidently of the same species. This also escaped. Within half an hour two others were met with, the latter of which was secured after several ineffectual attempts. It turns out to be "the Camberwell Beauty," a species whose geographical range comprises at least portions of both the old and new worlds, and upon this account may be regarded with more than ordinary interest. In some of the quotations to be given presently it will be seen that this insect is rare in Britain, and highly prized by collectors. It appears to be common in Canada. The following figure and description will perhaps enable the reader, who is not already acquainted with the species to recognize it.

Fig. 1.

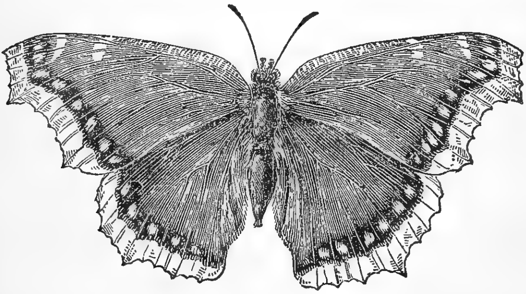

Fig. 1.—The Camberwell Beauty (*Vanessa Antiopa.*) Taken on the Mountain of Montreal, 24th April, 1857.*

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* Drawn and Engraved by Mr. J. Walker, Montreal.

Description.—The general colour of the upper side of the wings of this species is a deep chocolate brown, but with the hind and side margins ornamented with a cream coloured border. Between the cream-colour and the chocolate there is a second border consisting of a band of velvet black with a number of violet-blue spots. On the front margin of the anterior wing there are two yellowish spots on the outer half. The under sides of the wings are dark brown with some curved lines of black. There is also a small yellow spot near the middle of each wing on the under side, and two others on the border. It is, further, to be observed, that the white border on the upper side is sprinkled with minute black spots, and that there are some similar small spots, but of yellow on the front part of the wing in addition to the two large ones mentioned.

This species lives through the winter, and no doubt those I saw on the mountain had not long since left their hybernating retreats. The caterpillar is black with a series of red spots on the back, and with each articulation of the body armed with tufts of spines. It feeds upon the leaves of the poplar and willow, and according to some authors, on those of the elm. In a paper read before the Cleveland Academy of Natural Sciences, in 1854, by Prof. Kirtland, "On the Diurnal Lepidtoptera of Northern and Middle Ohio," it is stated that "*Vanessa Antiopa*—though a species introduced from Europe, has become very common. It often in its perfect state survives over the winter, and may be seen flying during the first days of spring. The larva, which often feeds on the foliage of the Lombardy poplar, excited strong prejudice some years since against such trees, from an erroneous belief that their tenant was venomous like Cleopatra's asp."

This caterpillar goes into the chrysalis state in July, and shortly after the new brood of butterflies may be seen flying about. It is said that there is a second brood of caterpillars, and the butterflies from them, on the approach of cold weather, retire into winter quarters, and come out again in the next spring.

The chrysalis is of a grey colour dappled with black, shaped something like the body and head of a grasshopper, without the wings and legs. It has a double row of spines on its vental side, and is suspended by the small end to the under side of a rail, branch of a tree, or other convenient support.

It is said this species has been introduced into America from Europe, and perhaps entomologists are in possession of knowledge

sufficient to enable them to decide a question of this kind. Upon this point I can give no opinion, but, on referring to several works, I find that in England it is there a rare species. The following extracts, taken from the Zoologist, 1846, will shew how it is prized by the entomologists of that country.

Occurrence of Vannessa Antiopa at York.—A specimen of this rare British butterfly was brought to me alive this day, which was caught in a garden in the suburbs of this city; it and two others were flying in company with the red admiral (*Vanessa Atalanta.*) The captor was unsuccessful with the others, he being only provided with a rhubarb leaf, with which he knocked the one down, that is now in my possession. —*Robert Cook, Colliergate, York.*"

" *Occurrence of Vannessa Antiopa near Epping.*—A female specimen of this insect was captured here on the 12th instant, and another seen. A fine female was also taken about the same time near Yaxely.—*Harry Doubbleday; Epping, September 20th,* 1846."

" *Occurrence of Vanessa Antiopa at Winchester.*—On Friday, September 4th, I had the pleasure of taking a fine female specimen of this rare and beautiful insect, near some willows; I have seen three others near the same spot.—*John T. Rogers; North Walls, Winchester.*"

" *Capture of Vanessa Antiopa near Stowmarket.*—Entomologists will be pleased to hear that they have now an opportunity of witnessing in a fine and perfect state, a specimen of the splendid butterfly, '*Vanessa Antiopa*'—Camberwell Beauty. A pair of this fine species were caught on Wednesday last, in the grounds of the Vicarage, Stowmarket, which, from their rare appearance, are rendered exceedingly interesting and remarkable, their visits here appear to be at very remote and uncertain periods, for until four or five years previous to 1819, Vanessa Antiopa had not been seen for nearly forty years, when it was observed in abundance in various parts of the kingdom. In 1819, a few were caught in Suffolk, and one was taken in the following spring, which had lived through the winter; since that period it has not been seen in England. Those caught at Stowmarket were found on the mulberry-tree, near the Vicarage House, planted by Milton, during his residence with the Rev. Dr. Young, the then Vicar, and who was tutor to the immortal poet, and no doubt the wide spreading branches of this celebrated tree attracted the notice of the butterflies in their search after food. We have been informed that Dr. Probart captured one of these beautiful insects in his garden one day last week.—*Ipswich Paper.*"

From the above extracts it will be seen that this insect, which is quite common in Canada, is regarded as an object of the greatest interest in Britain. The English specimens have the border pure white, and ours, although unquestionably the same species, is, therefore, one of those instances in which a difference of several thousands of miles in the geographical range of a

species is marked by a change sufficient perhaps to classify it as a permanent variety, but not to authorise a distinct, specific appellation. It is wonderful that so delicate a thing as a butterfly should be so widely distributed, and yet, another of our species, "The Painted Lady," *Crynthia Caqdui*, occurs in England, France, the Brazils, Africa, Iona, and New South Wales.* The "Red Admiral," *Vanessa Atalanta*, above mentioned, is another British butterfly which abounds in this country, and there are many others of which, it is to be hoped, some practical entomologist will volunteer to give an account in this Journal.

3. *The Isabella Tiger Moth.* (*Arctia Isabella.*)—Another interesting little object was the caterpillar of the Isabella tiger moth, easily recognised by its warm furry jacket, and by the peculiar distribution of the colours of its body, black at both ends, and red in the middle. When touched, it suddenly rolls itself up into a round ball, and remains motionless until the danger is past. Without understanding the wonderful transformations of insect life, who could fancy that this little mass of fur, in shape like a lady's boa, is destined in a few days to become a beautifully painted moth, no longer creeping on the ground on 16 short legs; but soaring through the air upon four delicate scale covered wings. Yet nothing is more true than this, that every caterpillar begins life as real *bona fide* caterpillar and ends it, provided the ordinary course of nature is not interrupted by some accident, as a winged insect. This moth is described by Professor Emmons in his work upon the insects of New York, as having the "thorax tawny and brownish: abdomen tawny, deeper colour beneath, and marked with three rows of black spots, about six or seven in each row, running on the back and middle of the sides. Forewings tawny, and marked with a few black scattering spots; hind wings nearly transparent, slightly tawny, and marked with six tawny spots; legs black or dark brown."

Professor Emmons says that the caterpillar feeds "upon sundry kinds of herbs;" but he does not inform us when it goes into the chrysalis state, or when the moth makes its appearance, and as I am unacquainted with the subject, I cannot, I am sorry to say, give any further information upon this point.

• The caterpillar of the Isabella tiger-moth, although itself a most harmless little creature, is often made the victim of other insects

* Wollaston on the Variation of Species, p. 32.

In a former number some account was given of the ichneumon flies, and of their mode of providing for their young, by depositing their eggs in the bodies of the larvæ of the wheat midge. All caterpillars are more or less subject to the same scourges. In the valuable little work published, Dr. Fitch, "On the noxious, beneficial and other insects, of the State of New York," the following interesting paragraph occurs.

"The knowledge and skill which these ichneumon and other parasitic hymenopters often shew in their proceedings are truly wonderful. Every person will recollect the larva of the Isabella tiger-moth, (*Arctia Isabella,*) the large caterpillar with stiff even-shorn hairs of a tan color, and black at each end of his body, which crawls about our yards, and often enters our dwellings, and will probably have observed the fact that if, when crawling, he is rudely touched, he suddenly stops and doubles himself together for a moment, and then straightens himself again and resumes his journey. The long stiff hairs with which he is protected, much like a porcupine, we should think would render it impossible for an insect enemy to place an egg anywhere upon his skin. Mr. P. Reid tells me he once saw one of these caterpillars crawling with a hurried eager step across a dusty road, with an ichneumon fly pursuing him, striving to cling upon his back, but falling off in consequence of the rapid motion of the caterpillar. The fly finding itself frustrated in its every effort, next, as if humming to itself the refrain, 'It will never do to give it up so,' flew a few feet forward of the caterpillar, and turning, darted back with all its energy, hitting the caterpillar square in his face. The caterpillar thus roughly assailed suddenly stopped, and bent himself together in his accustomed manner, and in an instant the fly alighting upon his back, appeared to fix an egg at the margin of one of the breathing pores, which had become fairly exposed by the caterpillar doubling his body thus together. In a moment the caterpillar was recovered from his shock, and was crawling rapidly forward again, when the fly struck him a second time in the same way, and thus he was stopped, and had an egg deposited in his side three times before he reached the tall grass beside the highway, in which he was secure from further molestation."

4. *Terrestrial Mollusca.*—While turning over the stones in search of geological specimens, I found during a single visit to the mountain no less than five species of land shells. Three of these were easly determined—a fourth appears to be a described

species, but of the fifth I can find no account, and it may be new. These two must, therefore, remain unnoticed for the present.

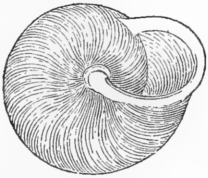


Fig. 2.

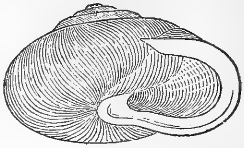


Fig. 3.

Figs. 2 *and* 3.—*Helix Albolabris* (Say.) (*The White Lipped Helix.*) Montreal Mountain, 24th April, 1857.

In the above two figures the largest and most common species is represented, and the following is the description given in Gould's Invertebrata of Massachusetts.

"Shell orbicular, depressed-conical, thin, shining, of a yellowish brown or russet-colour ; whorls five or six, rounded, separated by a well defined suture, and forming a moderately elevated spire, regularly and distinctly wrinkled by the lines of growth, which are crossed by very numerous, delicate, revolving hair lines, scarcely visible without a magnifier ; aperture, semi-elliptical, contracted by the lip, which is white and very broadly reflected ; outer edge sharp, somewhat waved, and coloured orange on the back ; umbilicus covered by the extremity of the lip. Diameter generally over one inch.

"The animal varies in color, sometimes being pure white, cream-colour or greyish ; head brownish above ; tentacula dusky at tip ; eyes black ; back shagreened with granular tubercles ; foot rather more than twice the diameter of the shell, pointed behind."

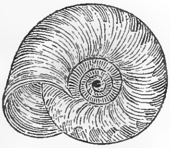
This is one of the most abundant of the few species of snails found in Canada. In all newly cleared lands the whitened shells of dead specimens are everywhere to be met with and living ones may be procured by searching under decaying logs, rotten stumps or stones. Limestone cliffs overgrown with small trees and herbage are more especially favoured haunts of this species. Dr. Gould remarks :

"This is our largest snail, and, though so simple in its structure and coloring, is a pleasing shell. Its delicately striated surface,

and broad white lip, cannot fail to gain admiration. It is subject to very little variety, the principal variations being the want of the white reflected lip, and the open umbilicus in its immature stages.

"The economy of these animals may be briefly stated as follows: They subsist upon decaying leaves and vegetable fibre, under which they usually shelter themselves. In moist weather and after showers, they issue from their retreats, and crawl over the leaves or up the trunks of trees, until driven back by a change of the weather. In early spring they are often seen collected in groups on the sunny side of the rocks. In June they deposit their eggs, to the number of thirty to eighty, in the light mould by the side of rocks and logs. These are white, opaque, and elastic; and in about twenty to thirty days the young animal issues from them with a shell consisting of one whorl and a half. In October they cease to feed, and select a place under some log or stone where they may be sheltered for the winter, and there they fix themselves with the mouth upwards. This they close by secreting a thin, transparent membrane, and as the weather becomes cold, they grow torpid and remain in that state until the warmth of spring excites them to break down the barrier, and enter upon a new campaign of duty and pleasure."

Fig 4.



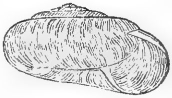


Fig. 5.

Figs. 4 *and* 5.—*Helix Alternata.* (Saz.)

This species is easily recognised when good specimens are procured, by the numerous bands of brown colour which ornament the surface. It is more depressed or flatter than *H. albolabris*, and the umbilicus is not covered over, but open, so that all the whorls may be seen from the under side. In the dead and partly decayed shells the colour for the greater part disappears, but the perfect ones make rather handsome cabinet specimens. It is thus described in the work above cited.

"Shell orbicular, depressed, slightly concave above and below; general tint a light fawn color, which, on the upper surface, alter-

nates, in about equal proportions, with oblique, zigzag bars of dark-brown; these bars grow narrower and lighter on the lower surface as they converge to the umbilicus; they are generally interrupted by a light coloured zone which issues from the middle of the inner margin of the aperture; whorls five to six, flattened above, conspicuously plaited at the lines of growth, so as to produce a rough surface above, but nearly smooth beneath; the shell has a sharp dividing line between the upper and lower surfaces in all its earlier stages, which disappears only at maturity, forming a circular aperture, slightly modified by the preceding whorl; lip simple and delicate; umbilicus large and deep, exhibiting all the volutions. Diameter often an inch.

"*Animal* with the head and tentacula of a light slate color, back brown, remainder of the upper surface brownish orange; eyes black; base of foot drab coloured; collar saffron. Tentacula one third of an inch long, blackish at tip. Foot not much exceeding the diameter of the shell, terminating in a broad, flat, obtuse tip; a light marginal line runs along the foot from the head to the posterior tip."

The habits of this species are similar to those of *H. Albolabris*.

Fig. 6. 

Fig. 6.—*Helix Monodon.* (Rackett.)

The species represented by Fig. 6.—"the single-toothed snail," is much smaller than either of the other two, and not so abundant. It has a sort of a tooth on the whorl just at the edge of the aperture. The technical description is thus given.

"Shell slightly convex; whorls five or six, narrow, diminishing very gradually in breadth from the outer whorl to the apex, marked by very fine lines of growth, and covered with a dark russet or chesnut coloured epidermis, which is beset with very minute, hair-like projections; aperture contracted by a deep groove behind the lip; lip white, narrow, reflexed, a little grooved on its face, extending on the base to the umbilicus, and slightly contracting it, and its outer edge not projecting beyond the surface of the whorl; umbilicus deep, not exhibiting all the volutions, partially covered by the lip; base rounded, very much excavated at the umbilical

region, with a compressed, elongated white tooth at the aperture. Greatest diameter nearly half an inch.

"*Animal* yellowish-brown, darker on the head and tentacula. Foot narrow, cylindrical, half as long again as the diameter of the shell, terminating in a point. Eyes black.

The hair-like projections above mentioned, and also represented in the figure, did not appear on the specimens I collected on the mountain, and Dr. Gould says they are often wanting at every stage of growth.

E. B.

ARTICLE XI.—*Instructions for Collecting and Preserving Insects.* By WILLIAM COUPER, Toronto, Cor. Mem. Lit. & His. Soc., Quebec, and Nat. His. Soc., Montreal.

During the last two years, I have had several letters from young men, residing in various parts of the Province, soliciting information with regard to the methods of collecting and preserving insects. This, of course, shews that entomology is rapidly coming into notice in Canada. To give the young Canadian tyro every information; to encourage and initiate as many as possible into the delightful study of entomology is my whole desire.

Canada, with its vast extent of forest and cultivated lands will surely continue to furnish fresh material to hundreds of entomologists, for many years to come. In England, there are not less than three hundred persons engaged in the study of entomology, and during the last few years many new species have been added to the old collections.

With one or two exceptions, the present collections of Canadian *Coleoptera* are either local or composed of captures made within certain limits; therefore, a thoroughly Canadian collection cannot be established until the parties who are engaged in the study, comes to some arrangement for the exchange of duplicates.

Very little has been done in *Lepidoptera*; I believe there is not one good collection of this Order in the Province, and yet, thousands of beautiful moths may be captured during summer. We are, therefore, far behind our neighbors in the United States, in our knowledge of this branch of entomology. Indeed, I may say the same of *Hymenoptera* and *Diptera*.

It is probably the difficulty of the pursuit that deter many from commencing it, but from experience I can say, that it is not so hard to learn as may be imagined, provided the tyro take an interest in it. He must be fully determined on what Order he is to study, as it is almost impossible to study all the Orders; and once resolved to follow any favorite branch, his next move will be towards the formation of a collection. "All entomologists begin (I believe, without exception) with being collectors of insects; and, therefore, he who is simply a collector of insects, is not on that acccount, to be despised. We do not see the apple trees produce fruit at once, but first comes the bud, then the blossom, and afterwards the fruit; so the collector of insects, his first desire is simply that of getting—

"Crecropias innatus apes amor urget habendi."

But even in pursuit of that object, he cannot but notice some modes of getting succeed better than others, that he finds certain insects in certain places, and so by degrees a habit of observation is formed. Now, of all branches of study, entomology is perhaps, the most attractive to the young. One great advantage is, that it is a pursuit which combines the healthful exercise of the sportsman with no small amount of head-work at home; and with this advantage over any other pursuit in which the outdoor exercise and the in-door study are totally disconnected, because here each reacts upon the other; the entomologist carefully examines a specimen under the microscope to ascertain to what group it should belong, and during his next walk he takes pains to observe the habits of the species when at large, in order to be able by analogy to trace with what species it has affinity."

Insects are to be looked for everywhere, nevertheless, there are certain places more productive than others. I may here state that I used the sweeping-net on the mountain behind Montreal, and also on the low shrubbery in that locality, situated between that city and Lachine; both of these places are very productive in Coleoptera. I captured four species of *Lebia*, as well as several species of *Curculionidœ* and *Cassidœ*. If there is an entomologist residing in Montreal, he should make frequent visits to these places.

Moss should be carefully examined (for the minuter species,) especially on the trunks of trees. The fungi and agarics must never be neglected, as they frequently teem with life. Dead ani-

mals, partially dried bones, are excellent traps for *Coleoptera*, especially *Necrophidæ*, *Silphidæ*, *Nitidulidæ*, *&c.* Planks and chippings of wood may be likewise employed as successful agents in alluring a vast number of species which might otherwise escape notice. The muddy banks of rivers, and the alluvial deposits of marshy grounds are pre-eminently rich, and must be carefully searched for *Carabidæ*, *Staphylinidæ*, &c. Felled timber should never be overlooked, especially beneath the bark. The waters, particularly stagnant pools, teem with life, and during the autumnal months the collector must be on the *qui vive* with his water net,* as several fine specimens of *Dyticidæ* and *Hydrophilidæ* can be added to his collection.

The *instrumenta belli* of the Coleopterist. A sweeping-net is the first thing to be obtained; strong brass wire makes the best ring for this net; then a bag is made of linen or berlin wool canvas to suit the size of the ring, which is attached to the end of a stick. The use of this net is to sweep low shrubbery, flowers and grass; the rarest and smallest beetles are captured with it. I use but one ring for all my nets, viz:—the sweeping, gauze, and water-nets; it is hinged in the centre, for the purpose of being more portable; the ends are bent round and flattened, so that one end sits on the other; the handle is of wood, and bored at one end, into which a screw is inserted. After the net is put on, the ends of the ring are placed upon the stick, and tightened with the screw. I carry all the nets in my pocket, and make use of them as required, and also use the handle as a walking stick.

A collecting bottle, (any wide mouthed one will answer) with a good cork stopper; the bottle should be encased in tin to prevent its being easily broken. My friend, F. H. Ibbetson, Esq., late Assistant Com. General, of Montreal, a profound entomologist, generally wrapped a piece of cotton around his collecting bottle, which he found to serve two purposes, to prevent any sudden blow on the tin breaking the bottle, and as a bandage, should any cut or injury be received. The bottle is half filled with fine saw-dust, which has been previously sifted through a piece of net, whereby all that is too coarse is separated; the saw-dust is then moistened with spirits of wine or good alcohol, and it is then ready for use. I use this method for collecting *Hemiptera*, *Orthoptera*, *Hymenoptera and diptera.*

* This net is made of coarse canvas, on the same principle as the sweeping-net.

Insects collected as above described, will keep fresh (provided the bottle is kept well corked), for upwards of a year, and are always in good condition for the cabinet.

A scizzors, camels-hair brushes, a pair of pliers, and pieces of card are necessary. A drying-box is the next requisite, one made of pine will answer the purpose, it must contain at least four boards to slide like drawers, the boards to be covered with cork, or any other soft material that pins can stick into.* After an excursion, the contents of the collecting bottle are emptied on a piece of white paper, and the new captives selected therefrom, and mounted on pins† suitable to the size of the insects. They are then placed in the drying-box, and left there until they are thoroughly dry, when they are transferred to the cabinet wherein the entomologist arranges his collection. The cabinet must be made to shut very close so as to exclude the dust and minute parasitic insects.

The pin should be stuck through the centre of either the right or left elytron of coleopterous insects; I find the right side to answer best, especially for small specimens.

HOW TO COLLECT LEPIDOPTERA.

To collect butterflies and moths on the wing, the entomologist must use a net which should be made of white book muslin, or of green lino or net. The insect when seen is pursued, and the instant it is captured a sharp turn is given to the net, and the specimen is a prisoner; a slight squeeze on the thorax with the finger and thumb, the insect becomes paralysed, and in that state pinned.

Nocturnal moths are often found asleep on palings or trunks of trees, and may be taken without the aid of the net; crepuscular species may also be found in the same position, but they will readily take alarm when the collector approaches, therefore, the net is necessary to capture them.

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* When cork cannot be procured the following composition will answer:—10 oz. of yellow rosin, 6 oz. of yellow wax, 2 oz. of tallow, and 1 oz. of turpentine. Melt them together over a fire, and when they are well melted and mixed, set the box or drawer upon a table or other place which is perfectly horizontal, then pour the mixture gently into the box, so as to cover the bottom about the tenth of an inch. Before it cools, cover it completely with white paper previously prepared.

† Entomological Pins may be obtained of W. Gale, Crown Court, Cheapside, London, England.

Moths are attracted by light. The English lepidopterists adopt the following plan to capture *Bombyces*, *Geometridæ*, *Pyralides*, and even the *Sphingidæ ;* sometimes the genus Smerinthus make their appearance. "To obtain moths by light it is advisable to have one light outside the room in advance of the window, and one inside the room; the former light bringing the moths within the sphere of attraction of the inner light. Those who try this plan will find that all nights are not equally successful; sometimes the moths will come in perfect swarms, and all sorts of rare species come to the collector, instead of his having to go in search of them; at other times, though the weather seems favorable, no moths will come, and the collector becomes disheartened, and declares the light "no go." It is no use to try light on a bright moonlight night, but dark and dull nights, with not much wind, are generally the best."

Butterflies and moths are pinned through the centre of the thorax, and held as nearly as possible vertical, if anything with a point rather inclining backwards. When a specimen is pinned on the setting-board or drying-box, then cut braces of card tapering nearly to a point, and place one under each of the wings to keep them in a horizontal position; in three or four days the insect becomes dry, then the braces may be removed, and the specimen transferred to the cabinet.

In summer care must be taken to exclude mites from the setting-boards as well as the cabinet. A mixture of equal parts of oil of thyme, oil of anise, and spirits of wine spread over the setting-board, together with a piece of camphor is necessary. Lepidopterous insects are also procured by means of what is termed a breeding-box, which is divided into compartments, with about six or seven inches of good earth, for such species as go through their transformations under ground care should be taken that the earth is free from vegetable matter, as it will mould and destroy the pupæ. The inside of the box should be rough, so that such caterpillars as form dry cocoons, can attach themselves more naturally; the top to be covered with gauze or wire frame. It requires considerable attention to feed caterpillars, therefore, it is much easier to hunt for pupæ and cocoons. For this purpose the lepidopterist must carry a tin-box containing some sand and moss, and a trowel: a round bladed one is best; with this instrument he can dig at the roots of trees, and other favorable localities. "No pupæ hunter can hope for success, unless he have a good

stock of patience and perseverance; he must not mind cold hands, wet feet, or an aching back, for, although these are drawbacks, yet is the pursuit quite exciting when successful, and it will reward the seeker, not merely of *Lepidoptera*, but also of all the other orders of insects." The best months for digging are September, October and November, if the weather permits.*

The generic name of each species determined, is written on a piece of paper fixed to the bottom of the same pin which supports the insect, and if possible procure both sexes, and place them side by side in the cabinet.

When the entomologist goes on an excursion, he should carry a blank book in his pocket, to note observations on the habits of insects. When thus he examines and observes for himself, he feels a greater ownership in the knowledge so obtained, than he would feel in any information derived from learning a passage in a book by heart. "A person may learn a great deal from books, and yet, from a want of observation, may be unable to read the pages of the book of nature, daily spreads out before us, ever fresh and ever interesting. Each time that the collector of insects catches a species which is new to him, he receives a thrill of pleasure, for he is adding a rarity to his collection." And these pleasures, it will be observed, though of so high an order, are positively within the reach of all; it has been well said, "happiness is within our reach if we will but take it," and such is entomology.

ARTICLE XII.—*The Muskrat, (Fiber Zibethicus.)*

GENUS FIBER.—Illiger.

DENTAL FORMULA.

Incisive $\frac{2}{2}$; *Molar* $\frac{3-3}{3-3} = 16$.

"Lower incisors, sharp-pointed, and convex in front; molars, with flat crowns, furnished with scaly transverse zig-zag laminæ. Fore-feet with four toes and the rudiment of a thumb; hind-feet,

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* I prefer the winter months to hunt for the cocoons of Bombyces, such *Attacasus luna*, *A. polyphemus*, *A. ceropia* and *prometheus*; they are more readily detected on account of the trees at this season being without foliage.

with five toes, the edges furnished with stiff hairs, which assist the animal in swimming, instead of the feet being palmated or webbed, hind-toes, slightly palmated. Tail, long, compressed, granular, nearly naked, having but a few scattered hairs. Glands, near the origin of the tail, which secrete a white, musky, and somewhat offensive fluid. Mammæ six, abdominal.

"This genus differs from the ARVICOLÆ in its dentition; the first inferior molar, has one point more than the corresponding tooth in the latter, and all the molars acquire roots immediately after the animal becomes an adult. We have frequently heard complaints made by students of natural history, of the difficulties they had to encounter at the very outset, from the want of accuracy and uniformity in the works of authors, when stating the characters by which they defined the genera they established. The justness of these complaints may be well illustrated by examining the acconnts of the present genus as given by several well-known writers.

"ILLIGER says it has four molars on each side, (*Utrinqui quaterni,*) see Prodomus systematis mammaliarum et avum, making in all twenty teeth. WIEGMAN and RUTHE, have given the same dental arrangement, see Handbuch der Zoologie, Berlin, 1832. F. CUVIER, who has been followed by most authors, has given it—Incisive $\frac{2}{2}$; Canine $\frac{3}{3}=\frac{3}{3}$, = sixteen teeth. GRIFFITH, Animal Kingdom, vol. iii., p. 106, describes it as having—Incisive $\frac{2}{2}$; Canine $\frac{4}{4}=\frac{4}{4}$ = twenty teeth; and in his synopsis of the species of mammalia, (sp. 532,) its dental arrangement is thus characterized —Incisive $\frac{2}{2}$, Canine $\frac{3}{3}=\frac{3}{3}$, Cheek-teeth, $\frac{3}{3}=\frac{3}{3}$, giving to it the extravagant nnmber of twenty-eight teeth. This last statement is most probably only a typographical error. A correct examination and description of the teeth of this genus requires a considerable degree of labour, besides great attention and care, as they are placed so close to each other that without a good magnifying glass it is difficult to find the lines of separation, and almost impossible to ascertain their number, without extracting them one by one.

"The descriptions and figures of their dental arrangement, by Baron CUVIER, and F. CUVIER are correct: see Ondatras, dents des mammifères, pl. 53, p. 157, and Recherches sur les ossemens fossiles, t. 5, p. 1.

"ILLIGER's generic name, Fiber, is derived from the latin word, *Fiber*, a beaver. There is only one species described as belonging to this genus."

FIBER ZIBETHICUS.—Linn.

THE MUSK-RAT.

It appears that the first correct description of the muskrat was prepared in 1725, by Monsieur *Sarrasin*, then king's physician at Quebec, and who was a correspondent of the French Academy. The animal had been previously most erroneously described by several authors, but Sarrasin's account was founded upon personal observation, and the dissection of numerous specimens, and furnished the materials which enabled Buffon to prepare a good article upon the species.

The muskrat inhabits every part of the United States north of 30°, and all British America to the Arctic seas; it has been found at the mouth of the *Mackenzie River*, in latitude 69°, on the Rocky Mountains, and on the Columbia, west of the chain. It is thus so organized that it can subsist in the coldest as well as in a climate bordering upon the tropical. Its habits are aquatic, spending the greater portion of its time when awake in the waters and procuring its food principally, in that element. Although occasionally seen in the day time, yet it is strictly a nocturnal animal, and consequently, rather difficult to observe. Fresh water mollusca roots of aquatic plants, and such tender grasses as may chance to grow at the margin of the stream constitute the food of the musk-rat. Along the banks of the Canadian rivers there may be occasionally seen great numbers of the shells of different species of *Unio* that have been opened and devoured by these animals. In one of the neighbouring States a gentleman who had a garden in the vicinity of a small stream was surprised to find that every night quantities of his turnips were carried away. Upon examination, the missing vegetables were traced to the muskrat houses at a considerable distance. Upon opening several of these, turnips, carrots, parsnips, and even ears of indian corn were found in plenty. The stalks of the latter are so tall that the ears are beyond the reach of the muskrat, but it was found that the animal, in order to obtain them, cut the stems off just above the roots with its sharp front teeth. Sir John Richardson states that: "In the autumn before the shallow lakes and swamps freeze over, the muskrat builds its house of mud, giving it a conical form, and a sufficient base to raise the chamber above the waters. The chosen spot is generally amongst the long grass, which is incorporated with the walls of the house, from the mud being deposited

amongst it; but the animal does not appear to make any kind of composition or mortar by tempering the mud and grass together. There is, however, a dry bed of grass deposited in the chamber. The entrance is under water. When ice forms over the surface of the swamp, the muskrat makes breathing holes through it, and protects them from the frost by a covering of mud. In severe winters, however, these holes freeze up in spite of their coverings, and many of the animals die. It is to be remarked that the small grassy lakes selected by the muskrat for its residence, are never so firmly frozen nor covered with such thick ice as deeper and clearer water. The Indians kill these animals by spearing them through the walls of their houses, making their approach with great caution, for the muskrats take to the water when alarmed by the sound on the ice. An experienced hunter is so well acquainted with the direction of the chamber and the position in which its inmates lie, that he can transfix four or five at a time. As soon as from the motion of the spear it is evident that the animal is struck, the house is broken down and it is taken out. The principal seasons for taking the musk-rat, are the autumn before the snow falls, and the spring after it has disappeared, but the ice is still entire. In the winter time the depth of snow prevents the houses and breathing holes from being seen. One of the first operations of the hunter is to stop all the holes with the exception of one at which he stations himself to spear the animals that have escaped being struck in their houses and come hither to breathe. In the summer the muskrat burrows in the banks of the lakes, making branched canals many yards in extent, and forming its nest in a chamber at the extremity, in which the young are brought forth. When its house is attacked in the autumn it retreats to these passages, but in the spring they are frozen up. The muskrat is a watchful but not a very shy animal. It will come very near to a boat or canoe, but dives instantly on perceiving the flash of a gun. It may be frequently seen sitting on the shores of small marshy islands in a rounded form, and not easily to be distinguished from a piece of earth, until, on the approach of danger it suddenly plunges into the water. In the act of diving, when surprised, it gives a smart blow to the water with its tail."

Sir John says that in the north there are three varieties:

1. The Black Musquash, rare.

2. The Pied Musquash, with dark blackish brown patches on a white ground.

3. The White Musquash.

The only kind we have seen in Canada is brown above and ash-coloured below. It is here principally taken by means of a steel trap like a common rat-trap, baited with parsnips, and set an inch or two under water. It is also shot, and can be taken in any kind of trap, as it has none of the cunning of the fox or the beaver. They are very prolific. It is said they breed three or four times in a year, and have from three to six young ones at a litter. In many of our Canadian rivers, even in the well settled Townships, there are small secluded bays, where, on account of the small elevation of the banks, the forest still remains, the trees overhanging the water. In such places especially, if there be a growth of reeds or other aquatic plants in the stream, the musk-rats build their houses, and when left undisturbed for a few years become very numerous.

Now and then a family of Indians on their way to the hunting grounds in the autumm will encamp in the vicinity, and in a few days exterminate the colony. We know of one of those places. There is an ancient fisherman living upon a small island near. He supports himself by selling the pike, perch and bass, the returns of his rod and line, and also turns many a penny by disposing the skins of the muskrats, the produce of his traps. He looks upon the rat plantation as his own legitimate property, and is loud in his indignation when two or three canoe-loads of Indians make their appearance.

The flesh of this animal is eaten by the Indians and trappers, and is said to be very good. As Audubon declares that the smell is less unpleasant than that of the skunk, the flesh may be relished by a hungry man, but from what we have seen of the species, we would as soon think of dining off a dish of any other kind of rats.

We do not know whether this species in its extreme northern haunts hybernates, or not.

DESCRIPTION.

"Body, of a nearly cylindrical shape, resembling that of the Norway rat. Head, short; neck, very short, and indistinct; legs, short; thighs, hid in the body, Tail, two-thirds the length of the body, compressed, convex on the sides, thickest in the middle,

tapering to an acute point at the extremity; covered with small scales, which are visible through the thinly scattered hairs. Incisors, large; upper ones a little rounded anteriorly without grooves, truncated on the cutting edge; lower ones, a little the longest; nose, thick, and obtuse; whiskers, moderate in length, seldom reaching beyond the ear; eyes, small and lateral, nearly concealed in the fur; ears, short, oblong, covered with hair, and hidden by the fur.

" On the fore-legs, the wrists and fingers only are visible beyond the body, they are covered with a short shining coat of hair.

" The thumb has a conspicuous palm, and is armed with a nail, as long as the adjoining finger nails. Hind-legs, as short as the fore-legs, so that the body when the animal is walking touches the ground.

" The hind-feet are turned obliquely inwards, and at first sight remind us of the foot of a duck. The two middle toes may be called semi-palmated, and there is also a short web between the third and fourth toes. The margins of the soles and toes, are furnished with an even row of rigid hairs, curving inwards; under-surface of feet, naked; claws, conical, and slightly arched.

" The whole body is clothed with a short, downy, fur, intermixed with longer and coarser hairs. In many particulars the skin resembles that of the beaver, although the fur is far less compact downy and lustrous.

COLOUR.

" Fur, on the upper parts a third longer than beneath; from the roots to near the extremities, blueish-gray, or lead-colour, tipped with brown; on the under surface it is a little lighter in colour, and the hairs are tipped with brownish-gray. This species, when viewed from above, appears of a general dark-brown colour with a reddish tint visible on the neck, sides, and legs; chin, throat, and under-surface, grayish-ash; tail, dark-brown. Incisors, yellow; nails, white. The colour of this animal, so much resembles that of the muddy banks on which it is frequently seated, that we have often, when looking at one from a little distance, mistaken it for a lump or clod of earth, until it moved.

DIMENSIONS.

"Length of head and body, ...	15 inches.
" of tail, ...	10 "
From heel to longest nail, ...	3 "
Height of ear, ...	½ "

Audubon and Bachman, Vol. 1, *p.* 108."

ARTICLE XIII.—*On the Wood-Chuck.* (*Arctomys Monax.*)

GENUS ARTOMYS, *Gmel. Cuv.*

DENTAL FORMULA.

Incisive $\frac{2}{2}$; *Canine* $\frac{0-0}{0-0}$; *Molar* $\frac{5-5}{4-4} = 22$.

" Incisors strong, narrow, and wedge-shaped, anterior surface rounded; molars, with the upper surface thick and heavy.

" Head large, mouth small, and placed below; eyes large, ears short, paws strong; fore-feet with four toes and the rudiment of a thumb; hind-feet with five toes; nails strong, compressd; tail bushy; no cheek pouches.

" The name *Arctomys*, is derived from two Greek words (*arktos*,) a bear, and (*mus*,) a mouse.

" There are as far as we are informed, but eight known species of the genus as it is now defined, five on the Eastern Continent and three in North America.

ARCTOMYS MONAX.—Linn.

Wood-Chuck. Maryland Marmot. Ground-Hog.

CHARACTERS.

" *Brownish-gray above; head, tail, and feet, dark-brown; nose and cheeks ashy-brown, under surface reddish.*

DESCRIPTION.

" The body is thick, and the legs are short, so that the belly nearly touches the ground. Head short and conical; ears short, rounded, and thinly clothed with hair on both surfaces; eyes moderate; whiskers numerous, extending to the ear; a membrane beneath the ears, on the posterior parts of the cheek, and a few setæ on the eye-brows; legs, short and muscular; fore-feet, with four toes, and the rudiment of a thumb, with a minute nail; hind-feet, with five toes. Toes long and well separated, palms naked, with tubercles at the roots of the toes. The middle toe longest—the first and third, which are nearly equal to each other, not much shorter; the extremity of the nail of the outer, extends only to the base of the nail of the adjoining toe; fore-claws moderately arched, obtuse and compressed; the soles of the hind-feet long, and naked to the heel; hind-feet semi-palmated; nails channelled

near the ends. Tail bushy, partly distichous; body clothed with soft woolly fur, which is mixed with coarse long hairs.

COLOUR.

" This species (like the foregoing one) is subject to many variations in the colour of its fur, which may account perhaps for its numerous synonymes. We will, however, describe the animal in its most common colouring.

" The finer woolly fur is for two-thirds of its length from the roots upwards, of a dark ashy brown, with the extremities light yellowish-brown. The long hairs are dark brown for two-thirds of their length, tipped sometimes with reddish white, but generally with a silvery white. The general tint of the black is grizzly or hoary; cheeks, and around the mouth, light gray; whiskers black; head, nose, feet, nails and tail, dark brown; eyes black. The whole under surface, including the throat, breast, belly, and the fore and hind legs, reddish orange.

" The specimens before us present several striking varieties of colour; among them is one from Lower Canada, coal-black with the exception of the nose and a patch under the chin, which are light gray; the fur is short, and very soft; and the tail less distichous than in other varieties of this species.

DIMENSIONS.

" Adult Male.

From point of nose to root of tail, - - - -	$18\frac{3}{4}$	inches.
Tail (vertebræ,) - - - - - - - - - - - - - -	$3\frac{7}{8}$	"
Tail, to end of hair, - - - - - - - - - - -	$5\frac{7}{8}$	"
Ear, posteriorly, - - - - - - - - - - - - -	$\frac{3}{4}$	"
Girth of body, - - - - - - - - - - - - - -	17	"
From fore to hind claw, when stretched, - -	26	"

" We have found some difference in the length of the tail, in different individuals, it being, in some specimens, nearly seven inches long including the hair.

" Weight 9lb. 11 oz.—*Audubon and Bachman, Vol.* 1, *p.* 16."

The Woodchuck belongs to the order RODENTIA* or the "gnawers," that group of the mammalia which includes the beaver, muskrat, hares, mice, rats, and rabbits. The animals of this order have the two front or incisor teeth in each jaw constructed like so many chisels for the purpose of cutting to pieces the va-

rious vegetable substances upon which they subsist. The extraordinary labours of the beaver, or even the mischief that can be effected by a common rat are good proofs of the efficiency of such instruments. These teeth have the enamel only on the front sides, so that the posterior portion being the softest, is worn away more rapidly and leaves a sharp edge where it is most needed. The jaws of the Rodents, also, are so articulated and contrived, that they have no motion sideways, but only in a direction from behind forwards.

The woodchuck is found throughout the north-eastern United States, Nova Scotia, New Brunswick, Canada, and also, it is said, in the Hudson's Bay territory. It is a harmless little animal, subsisting upon vegetable food during the summer, and sleeping during the winter. The young are brought forth in May or June, generally four or five in a litter, but sometimes seven or eight. The burrow in which each pair resides, is usually dug in the side of a small sandy or gravelly eminence, and often in a perfectly level field. It is at first a little sloping downwards, and then continued along horizontally, sometimes twenty or thirty feet when it is terminated, in a comfortable round chamber where the occupants can dwell in security. About the time the leaves fall in the autumn, these animals retire to their burrows, roll themselves up, and remain quite torpid until spring. When taken out in this state they can be rolled about like a ball without being relaxed. While feeding, they keep the upright position, stooping down to get a mouthful, and then sitting upright to eat it. When pursued, they usually manage to get to their burrows pretty quickly, or if such a place of retreat be more convenient, into a pile of loose stones or old logs. They do not store up provisions as is generally supposed. In the autumn they become exceedingly fat, and their flesh is not bad eating. In Canada, this animal is called by the French habitans, *Siffleur*, and by English, the woodchuck, ground-hog, or marmot. They bite severely, and will fight with a dog several times their own size. They are sometimes seen in the woods erect, with their backs against a tree, asleep in the warm sunshine.

It appears that the species described by Sir John Richardson under the name of *Arctomys empetra*, is the same as *A. monx*. The following anecdote relating to the hybernation of the woodchuck is given in Audubon & Bachman's work.

"Concerning this latter most singular state of existence, we are gratified in being able to communicate the following facts, related to us by the Hon. Daniel Wadsworth, of Hartford, Connecticut. "I kept," said he to us, "a fine Wood-Chuck in captivity, in this house, for upwards of two years. It was brought to me by a country lad, and was then large, rather wild, and somewhat cross and mischievous; being placed in the kitchen, it soon found a retreat, in which it remained concealed the greater part of its time every day. During several nights it attempted to escape by gnawing the door and window-sills; gradually it became more quiet, and suffered itself to be approached by the inmates of the kitchen, these being the cook, a fine dog, and a cat; so that ere many months had elapsed, it would lie on the floor near the fire, in company with the dog, and would take food from the hand of the cook. I now began to take a particular interest in its welfare, and had a large box made for its use, and filled with hay, to which it became habituated, and always retired when inclined to repose. Winter coming on, the box was placed in a warm corner, and the Wood-Chuck went into it, arranged its bed with care, and became torpid. Some six weeks having passed without its appearing, or having received any food; I had it taken out of the box, and brought into the parlour;—it was inanimate, and as round as a ball, its nose being buried as it were in the lower part of his abdomen, and covered by its tail—it was rolled over the carpet many times, but without effecting any apparent change in its lethargic condition, and being desirous to push the experiment as far as in my power, I laid it close to the fire, and having ordered my dog to lie down by it, placed the Wood-Chuck in the dog's lap. In about half an hour, my pet slowly unrolled itself, raised its nose from the carpet, looked around for a few minutes, and then slowly crawled away from the dog, moving about the room as if in search of its own bed! I took it up, and had it carried down stairs and placed again in its box, where it went to sleep, as soundly as ever, until spring made its appearance. That season advancing, and the trees showing their leaves, the Wood-Chuck became as brisk and gentle as could be desired, and was frequently brought into the parlour. The succeeding winter this animal evinced the same disposition, and never appeared to suffer by its long sleep. An accident deprived me of my pet, for having been trodden on, it gradually became poor, refused food, and finally died extremely emaciated."

"May we here be allowed to detain you, kind reader, for a few moments, whilst we reflect on this, one among thousands of other instances of the all-wise dispensations of the Creator. Could any of the smaller species of quadrupeds, incapable, as many of them are, of migrating like the swift-winged inhabitants of the air to the sunny climes of the South, and equally unable to find any thing to subsist on among the dreary wastes of snow, or the frost-bound lands of the North during winter, have a greater boon at the hands of Nature than this power of escaping the rigours and cold blasts of that season, and resting securely, in a sleep of insensibility, free from all cravings of hunger and all danger of perishing with cold, till the warm sun of spring, once more calls them into life and activity? Thus this and several other species of quadrupeds, whose organization in this respect differs so widely from general rules, may be said to have no winter in their year, but enjoy the delightful weather of spring, summer, and autumn, without caring for the approach of that season during which other animals often suffer from both cold and hunger."

ARTICLE XIV.—*On the "Fisher" or Pekan. "Pennant's Marten."* (*Mustela Canadensis.*)

GENUS MUSTELA.—Cuv.

DENTAL FORMULA.

Incisive $\frac{6}{6}$; *Canine* $\frac{1}{1}—\frac{1}{1}$; *Molar* $\frac{5-5}{6-6}$ = 38.

"Head, small and oval; muzzle, rather large; ears, short and round; body, long, vermiform; tail, usually long and cylindrical; legs, short; five toes on each foot, armed with sharp, crooked, slightly retractile claws. No anal pouch, but a small gland which secretes a thickish offensive fluid. Fur, very fine.

"This genus differs from the genus Putorius, having four carnivorous teeth on each side, in the upper jaw, instead of three, the number the true weasels exhibit, and the last carnivorous tooth on the lower jaw, has a rounded lobe on the inner side, which renders this genus somewhat less carnivorous in its habit than Putorius, and consequently a slight diminution of the cruelty and

ferocity displayed by animals of the latter genus, may be observed in those forming the present.

"There are about twelve species of true Martens known, four of which inhabit North America.

"The generic name Mustela, is derived from the Latin word *mustela*, a weasel.

MUSTELA CANADENSIS.—Schreber.

Pennant's Marten or Fisher.

Black Fox or Black Cat of the Northern Hunters.

CHARACTERS.

"*Head and shoulders, mixed with grey and brown ; nose, lips, legs, and tail, dark brown.*

SYNONYMES.

Le Pekan, Buffon, vol. xiii., p. 304, A.D. 1749.
Mustela Canadensis, Schreber, Saugeth. p. 492, 1775.
Mustela Pennanti, Erxleben, Syst., p. 470, A.D. 1777.
Fisher, Penn., Arct. Zool., 4 vols., vol. i., p. 82, A.D. 1784.
Mustela Canadensis, Gmel., Lin., vol. i., p. 95, 1788.
Wejack, Hearne's Journey.
Fisher, or Black Fox, Lewis and Clarke, vol. iii., p. 25.
Fisher, Weasel, or Pekan, Warden's United States.
Mustela Pennanti, Sabine, Frank. First Journey, p. 651.
Mustela Canadensis, Harlan, F., p. 65.
" " Godman, vol. i., p. 203.
Mustela Godmani, Less., Mamm., p. 150.
Mustela Canadensis, Rich., F. B. A., p. 52.
Pekan, or Fisher, Dekay, Nat. His. N.Y., p. 31.

DESCRIPTION.

"The head of this species bears a stronger resemblance to that of a dog than to the head of a cat. Its canine teeth, in the upper jaw, are so long that with the slightest movement of the lip they are exposed. Head, broad and round, contracting rather suddenly toward the nose, which is acute. Eyes, rather small and oblique; ears, low, broad, semicircular, and far apart, covered on both surfaces with short soft fur; whiskers, half the length of the head; body, long, and formed for agility and strength.

"The pelage is formed of a short fine down next the skin, intermixed with longer and coarser hairs about an inch and a half in length; these hairs are longer on the posterior parts of the animal than on the shoulders.

"The feet are robust. Fore-feet, shorter than the hind-feet, thickly clothed with rather fine and short hairs; nails, long, strong, curved, and sharp; soles, hairy; the toes on all the feet are connected at the base by a short hairy web; the callosities consequently make only a slight impression when the animal is walking or running on the snow.

"Tail, long, bushy, and gradually diminishing to a point toward the extremity.

"This species has so strong a smell of musk (like the pine marten,) that we have found the skin somewhat unpleasant to our olfactories, several years after it had been prepared as a specimen.

COLOUR.

"Fur on the back, from the roots to near the extremity, chesnut-brown, tipped with reddish-brown and light grey. On the head, shoulders, and fore part of the back, there are so many long whitish hairs interspersed, that they produce a somewhat hoary appearance. Whiskers, nose, chin, ears, legs, feet, and tail, dark-brown; margins of the ears, light-brown; hips and posterior part of the back, darker than the shoulders; eyes, yellowish-brown; nails, light horn-colour.

"In some specimens we have seen a white spot on the throat, and a line of the same colour on the belly; others, have no white markings on the body. We have seen a specimen, nearly white, with a brown head. Another obtained in Buncombe county, North Carolina, was slightly hoary on the whole upper surface.

DIMENSIONS.

"From point of nose to root of tail	23 inches.
Tail (vertebræ)	12 do.
" to end of hair	$14\frac{1}{2}$ do.
Breadth of head	$3\frac{1}{2}$ do.
Height of ear	1 do.
Breadth of ear	2 do.
From point of nose to eye	2 do.
" heel to point of longest nail	$4\frac{1}{4}$ do.

Weight, $8\frac{1}{2}$ lbs.

—AUD. & BACH., p. 307.

The Fisher or Pekan is about the size of a small fox, of a general dark brown or nearly black colour, frequents swampy lands, and preys upon fish, frogs, squirrels, mice, and other small animals. It is found all over the continent as far south as the Carolinas. In the newly settled portions of Canada, it occurs rarely, but wherever there is a dense population, it never is seen.

Very little appears to be known of the habits of this the largest true marten of North America. The hunters complain that, like the carcajou, the fisher will follow a line of marten traps-breaking them in pieces and devouring the bait.

We know of at least one instance of this kind. A school teacher in one of the new townships occupied his leisure hours in trapping various animals. Several times in succession he found that an animal of some kind had gone the whole of his round and not only stolen all his bait, but had even torn a marten to pieces which had been caught. In order to arrive at some further acquaintance with this mysterious visitor, he set a stout steel trap baited with a bird near one of his "dead-falls," and the next morning found secured in it a large fisher, who made a fierce battle with the dog, although one of his legs was fast in the trap. Another was shot near Port Hope in Upper Canada, by a hunter named Marsh, who said it was up a tree in pursuit of a marten. Marsh killed them both. Sir John Richardson says the fisher preys much upon frogs, but will also kill the Canada porcupine by biting it in the belly. About forty years ago, when this animal was more common in the state of New York, the hunters used to obtain them by following their tracks in the snow, when the auimals had been out in quest of food on the previous night, thus tracing them to the hollow trees in which they were concealed, which they chopped down. It is said that as the tree was falling, the fisher would dart from the hollow which was often fifty feet from the ground, and leap into the snow, when the dogs usually seized and killed him, although not without a hard struggle, as this animal is greatly more dangerous to dogs and hounds than either the grey or red fox.

When taken alive and kept in confinement, it is said they are usually sullen and voracious, growling, snapping and spitting when approached. They are nocturnal in their habits, although sometimes seen abroad during the day.

It is said they bring forth once a year, depositing their young in the trunk of a large tree usually thirty or forty feet from the ground. A female was killed in the month of April pregnant with three young.

ARTICLE XV.—*On the Beaver.—Castor fiber.*

GENUS CASTOR.—Linn.

DENTAL FORMULA.

Incisive $\frac{2}{2}$; *Canine* $\frac{0}{0}$—$\frac{0}{0}$; *Molar* $\frac{4}{4}$—$\frac{4}{4}$ = 20.

"Incisors very strong. In the upper jaw their anterior surface is flat and their posterior surface angular. The molars differ slightly from each other in size, and have one internal and three external grooves. In the lower jaw the incisors present the same appearance as those of the upper; but are smaller. In the molars there are three grooves on the inner side, with one on the external.

"Eyes small; ears short and round; five toes on each foot. On the fore-feet the toes are short and close; on the hind-feet long and palmated. Tail, large, flat, and scaly. Mammæ, four, pectoral: a pouch near the root of the tail, in which an unctuous matter is secreted.

"There is but one well established species known to belong to this genus.

"The generic name is derived from the Latin word *Castor*, a beaver.

CASTOR FIBER.—Linn.

(VAR. AMERICANUS.)

American Beaver.

CHARACTERS.

Larger than the ground-hog, (Arctomys monax;) of a reddish-brown colour, with a short downy grayish fur beneath; tail, flat, scaly, and oval.

DESCRIPTION.

"The shape of the body bears a considerable resemblance to that of the musk-rat; it is, however, much larger, and the head is proportionally thicker and broader. It is thick and clumsy, gradually enlarging from the head to the hips, and then is somewhat abruptly rounded off to the root of the tail.

"Nose, obtuse and divided; eyes, small; ears, short, rounded, well clothed with fur, and partially concealed by the longer surrounding hairs: moustaches, not numerous, but very rigid, like hogs' bristles, reaching to the ears; neck, rather short. The fur is of two kinds. The upper and longer hair is coarse, smooth, and glossy; the under coat is dense, soft, and silky. Fore-feet, short and rather slender; toes, well separated and very flexible. The fore-feet are used like hands to convey food to the mouth. The fore-claws are strong, compressed, and channelled beneath. The middle toe is the longest, those on each side a little shorter, and the outer and inner ones shortest.

"The hind-feet bear some resemblance to those of the goose. They are webbed beyond the roots of the nails, and have hard and callous soles. In most of the specimens we have seen, there is a double nail on the second inner toe. The palms and soles are naked. When walking, the whole heel touches the ground. The Beaver is accustomed to rest itself on its hind-feet and tail, and when in this sitting position contracts its fore-claws in the manner of the left hand figure represented in the plate. The upper surface of all the feet, with the exception of the nails, which are naked, is thickly covered with short adpressed hairs.

"The tail is very broad and flat, tongue-shaped, and covered with angular scales. The root of the tail is for an inch covered with fine fur. The glandular sacs containing the castoreum, a musky unctuous substance, are situated near the anus.

COLOUR.

Incisors, on their outer surface, orange; moustaches, black; eyes, light-brown. The soft under down is light grayish-brown. The upper fur on the back is of a shining chesnut colour; on the under surface, and around the mouth and throat, a shade lighter. Nails, brown; webs between the toes, and tail, grayish-brown. We have seen an occasional variety. Some are black; and we examined several skins that were nearly white.

DIMENSIONS.

From nose to root of tail,	23 inches.
Tail,	10 do.
From heel to end of middle claw,	$5\frac{1}{2}$ do.
Greatest breadth of tail,	$3\frac{1}{4}$ do.
Thickness of tail,	$\frac{7}{8}$ do.

Weight, $11\frac{1}{4}$ lbs.

The geographical range of the beaver appears to have been at one time co-extensive with the whole of North America, from the Arctic Ocean south, to the Tropic of Cancer, or Gulf of Mexico. The progress of civilization has, however, exterminated the animal in nearly all of that portion of the continent which constitutes the United States and the settled portions of Canada. North of the Ottawa, and in the head waters of the streams which flow into the St. Lawrence below Montreal, it is still abundant. An exploring party in crossing the wild country between Matchedash Bay at the southern extremity of the Georgian Bay, to the county of Renfrew in 1853, saw great numbers of their works in the numerous streams and lakes of that region. They are therefore still quite common between Lake Huron and the Ottawa.

The American beaver cannot be distinguished from that of Europe. The fur of the latter is a little lighter in colour than that of this continent. It was once an inhabitant of the British Islands, where it has been found associated with the remains of the extinct mammoth. There is also an extinct beaver, whose remains have been discovered in Europe and another in America, which appear to have been the size of a sheep. The following is the best account we have seen of the habits of this species.

"Beavers prefer small clear-water rivers and creeks, and likewise resort to large springs. They, however, at times, frequent great rivers and lakes. The trappers believe that they can have notice of the approach of winter weather, and of its probable severity, by observing the preparations made by the Beavers to meet its rigours; as these animals always cut their wood in good season, and if this be done early, winter is at hand.

The Beaver dams, where the animal is at all abundant, are built across the streams to their very head waters. Usually these dams are formed of mud, mosses, small stones, and branches of trees cut about three feet in length and from seven to twelve inches round. The bark of the trees in all cases being taken off for winter provender, before the sticks are carried away to make up the dam. The largest tree cut by the Beaver, seen by Prevost, measured eighteen inches in diameter; but so large a trunk is very rarely cut down by this animal. In the instance just mentioned, the branches only were used, the trunk not having been appropriated to the repairs of the dam or aught else by the Beavers.

In constructing the dams, the sticks, mud and moss are matted and interlaced together in the firmest and most compact manner;

so much so that even men cannot destroy them without a great deal of labour. The mud and moss at the bottom are rooted up with the animal's snout, somewhat in the manner hogs work in the earth, and clay and grasses are stuffed and plastered in between the sticks, roots, and branches, in so workmanlike a way as to render the structure quite water-tight. The dams are sometimes seven or eight feet high, and are from ten to twelve feet wide at the bottom, but are built up with the sides inclining towards each other, so as to form a narrow surface on the top. They are occasionally as much as three hundred yards in length, and often extend beyond the bed of the stream in a circular form, so as to overflow all the timber near the margin, which the Beavers cut down for food during winter, heap together in large quantities, and so fasten to the shore under the surface of the water, that even a strong current cannot tear it away; although they generally place it in such a position that the current does not pass over it. These piles or heaps of wood are placed in front of the lodges, and when the animal wishes to feed he proceeds to them, takes a piece of wood, and drags it to one of the small holes near the principal entrance running above the water, although beneath the surface of the ground. Here the bark is devoured at leisure, and the wood is afterwards thrust out, or used in repairing the dam. These small galleries are more or less abundant according to the number of animals in the lodges. The larger lodges are, in the interior, about seven feet in diameter, and between two and three feet high, resembling a great oven. They are placed near the edge of the water, although actually built on or in the ground. In front, the Beavers scratch away the mud to secure a depth of water that will enable them to sink their wood deep enough to prevent its being impacted in the ice when the dam is frozen over, and also to allow them always free egress from their lodges, so that they may go to the dam and repair it if necessary. The top of the lodge is formed by placing branches of trees matted with mud, grasses, moss, &c., together, until the whole fabric measures on the outside from twelve to twenty feet in diameter, and is six or eight feet high, the size depending on the number of inhabitants. The outward coating is entirely of mud or earth, and smoothed off as if plastered with a trowel. As Beavers, however, never work in the daytime, no person we believe has yet seen how they perform their task, or give this hard-finish to their houses. This species does not use its fore-feet in swimming, but for carrying burthens: this

can be observed by watching the young ones, which suffer their fore-feet to drag by the side of the body, using only the hind-feet to propel themselves through the water. Before diving, the Beaver gives a smart slap with its tail on the water, making a noise that may be heard a considerable distance, but in swimming, the tail is not seen to work, the animal being entirely submerged except the nose and part of the head; it swims fast and well, but with nothing like the speed of the otter, (*Lutra Canadensis.*)

The Beavers cut a broad ditch all round their lodge, so deep that it cannot freeze to the bottom, and into this ditch they make the holes already spoken of, through which they go in and out and bring their food. The beds of these singular animals are separated slightly from each other, and are placed around the wall, or circumference of the interior of the lodge; they are formed merely of a few grasses, or the tender bark of trees: the space in the centre of the lodge being left unoccupied. The Beavers usually go to the dam every evening to see if repairs are needed, and to deposit their ordure in the water near the dam, or at least at some distance from their lodge.

They rarely travel by land, unless their dams have been carried away by the ice, and even then they take the beds of the rivers or streams for their roadway. In cutting down trees they are not always so fortunate as to have them fall into the water, or even towards it, as the trunks of trees cut down by these animals are observed lying in various positions; although as most trees on the margin of a stream or river lean somewhat towards the water, or have their largest branches extended over it, many of those cut down by the Beavers naturally fall in that direction.

It is a curious fact, says our trapper, that among the Beavers there are some that are lazy and will not work at all, either to assist in building lodges or dams, or to cut down wood for their winter stock. The industrious ones beat these idle fellows, and drive them away; sometimes cutting off a part of their tail, and otherwise injuring them. These "Paresseux" are more easily caught in traps than the others, and the trapper rarely misses one of them. They only dig a hole from the water running obliquely towards the surface of the ground twenty-five or thirty feet, from which they emerge when hungry, to obtain food, returning to the same hole with the wood they procure, to eat the bark.

They never form dams, and are sometimes to the number of five or seven together; all are males. It is not at all improbable, that

these unfortunate fellows have, as is the case with the males of many species of animals, been engaged in fighting with others of their sex, and after having been conquered and driven away from the lodge, have become idlers from a kind of necessity. The working Beavers, on the contrary, associate, males, females, and young together.

Beavers are caught, and found in good order at all seasons of the year in the Rocky Mountains; for in those regions the atmosphere is never warm enough to injure the fur; in the low-lands, however, the trappers rarely begin to capture them before the first of September, and they relinquish the pursuit about the last of May. This is understood to be along the Missouri, and the (so called) Spanish country.

Cartwright, (vol. i., p. 62.) found a Beaver that weighed forty-five pounds; and we were assured that they have been caught weighing sixty-one pounds before being cleaned. The only portions of their flesh that are considered fine eating, are the sides of the belly, the rump, the tail, and the liver. The tail, so much spoken of by travellers and by various authors, as being very delicious eating, we did not think equalled their descriptions. It has nearly the taste of beef marrow, but is rather oily, and cannot be partaken of unless in a very moderate quantity, except by one whose stomach is strong enough to digest the most greasy substances.

Beavers become very fat at the approach of autumn; but during winter they fall off in flesh, so that they are generally quite poor by spring, when they feed upon the bark of roots, and the roots, of various aquatic plants, some of which are at that season white, tender, and juicy. During winter, when the ice is thick and strong, the trappers hunt the Beaver in the following manner. A hole is cut in the ice as near as possible to the aperture leading to the dwelling of the animal, the situation of which is first ascertained; a green stick is placed firmly in front of it, and a smaller stick on each side, about a foot from the stick of green wood; the bottom is then patted or beaten smooth and even, and a strong stake is set into the ground to hold the chain of the trap, which is placed within a few inches of the stick of green wood, well baited, and the Beaver, attracted either by the fresh bark or the bait, is almost always caught. Although when captured in this manner, the animal struggles, diving and swimming about in its efforts to escape, it never cuts off a foot in order to obtain its liberty; probably be-

cause it is drowned before it has had time to think of this method of saving itself from the hunter. When trapping under other circumstances, the trap is placed within five or six inches of the shore, and about the same distance below the surface of the water, secured and baited as usual. If caught, the Beavers now and then cut off the foot by which they are held, in order to make their escape.

A singular habit of the Beaver was mentioned to us by the trapper, Prevost, of which we do not recollect having before heard. He said that when two Beaver lodges are in the vicinity of each other, the animals proceed from one of them at night to a certain spot, deposit their castoreum, and then return to their lodge. The Beavers in the other lodge, scenting this, repair to the same spot, cover it over with earth, and then make a similar deposit on the top. This operation is repeated by each party alternately until quite a mound is raised, sometimes to the height of four or five feet.

The strong musky substance contained in the glands of the Beaver, is called castoreum; by trappers, bark-stone; with this the traps are baited. A small stick, four or five inches long, is chewed at one end, and that part dipped in the castoreum, which is generally kept in a small horn. The stick is then placed with the anointed end above water, and the other end downwards. The Beaver can smell the castoreum at least one hundred yards, makes towards it at once, and is generally caught.

Where Beavers have not been disturbed or hunted, and are abundant, they rise nearly half out of water at the first smell of the castoreum, and become so excited that they are heard to cry aloud, and breathe hard to catch the odour as it floats on the air. A good trapper used to catch about eighty Beavers in the autumn, sixty or seventy in the spring, and upwards of three hundred in the summer, in the mountains; taking occasionally as many as five hundred in one year. Sixty or seventy Beaver skins are required to make a pack weighing one hundred pounds; which, when sent to a good market, is worth, even now, from three to four hundred dollars.

It is stated by some authors that the Beaver feeds on fish. We doubt whether he posesses this habit, as we on several occasions placed fish before those we saw in captivity, and although they were not very choice in their food, and devoured any kind of vegetable, and even bread, they in every case suffered fish to remain untouched in their cages.

The food of this species, in a state of nature, consists of the bark of several kinds of trees and shrubs, and of bulbous and other roots. It is particularly fond of the bark of the birch, (*Betula*,) the cotton-wood, (*Populus*,) and of several species of willow, (*Salix*;) it feeds also with avidity on the roots of some aquatic plants, especially on those of the *Nuphair luteum*. In summer, when it sometimes wanders to a distance from the water, it eats berries, leaves, and various kinds of herbage.

The young are born in the months of April and May; those produced in the latter month are the most valuable, as they grow rapidly and become strong and large, not being checked in their growth, which is often the case with those that are born earlier in the season. Some females have been taken in July, with young, but such an event is of rare occurrence. The eyes of the young Beaver are open at birth. The dam at times brings forth as many as seven at a litter, but from two to five is the more usual number. The young remain with the mother for at least a year, and not unfrequently two years, and when they are in a place of security where an abnndance of food is to be procured, ten or twelve Beavers dwell together.

About a month after their birth, the young first follow the mother, and accompany her in the water; they continue to suckle some time longer, although if caught at that tender age, they can be raised without any difficulty, by feeding them with tender branches of willows and other trees. Many Beavers from one to two months old are caught in traps set for old ones. The gravid female keeps aloof from the male until after the young have begun to follow her about. She resides in a separate lodge till the month of August, when the whole family once more dwell together."

ARTICLE XVI.—*Hints to the Young Botanist, regarding the collection, naming and preserving of Plants.*

The season for collecting plants in the vicinity of Montreal may be said to commence towards the latter end of April and to extend to the beginning of October. But few plants will reward the early excursions of the botanist, who will measure their value and interest proportionally. Immediately on the melting of the snow, appear the *Hepatica triloba*, with its purplish-white flowers, the

Sanguinaria Canadensis, with its palmate-lobed leaf and rich white flower, and the delicate *Claytonia*, with its pretty rose-colored Corolla, and the discovery of even one of these floral pioneers in early spring, gives as much gratification to the mind of the excursionist, as the richer and more luxuriant collections of midsummer. The Composite plants of August and September, the waving Grasses, the Ferns with their handsome fronds, and the delicate tufted Mosses adorn the autumnal season, whose close is marked by the bright and picturesque tints of leaves that once were green. The varieties of flowers characteristic of spring, summer and autumn, form a pleasing contrast to the mind, and this circumstance alone stimulates the enthusiasm of the botanist to continue his researches sedulously in the field till plants be no more.

The young botanist, who commences the collection and preserving of plants, should determine to prosecute his labours with zeal and assiduity. Without this ennobling spirit, he will ere long find what he at first considered a pleasure, to become an arduous task, fruitful of no enjoyment. His excursions to the country should be frequent, and as varied as possible; visiting mountain, hill, field, forest, valley, marsh, island, river and lake-shores. He should make a point, also, of collecting and preserving specimens of every plant that crosses his path, in order to render his herbarium a complete one. He can adopt no better plan at the begining than to confine himself to a certain well-defined district, and to collect all the plants within it. When his herbarium of the district is complete, it will be of greater value than a larger but more scattered collection, and should opportunity permit, he can readily extend his researches over a wider range of country. To a resident in Montreal, its Mountain, so rich in plants and so near at hand, affords facilities for the formation of a beautiful herbarium of no small size, or the Island itself, if botanized throughout its whole extent, will furnish a characteristic collection of plants, many of them to be found within an extended range of latitude and longitude on either side. To relieve the monotony of a botanical excursion, it is advisable to be accompanied by one or more companions, who, besides affording pleasant society, will often be more fortunate in finding plants, and none more willing to favor another with duplicate specimens.

On starting upon a botanical excursion, it is requisite to be equipped with convenient apparatus for collecting and carrying plants. The following may be mentioned among the instruments most required:

1. A good *stout pocket-spud* or *digger*, made of steel, and furnished with a slightly curved wooden handle, pierced to allow a string to pass through, whereby it may be attached to a strap or belt round the waist. It will often be found useful in digging out roots and detaching plants from the crevices of rocks. If it be not obtained, a very good substitute is a *strong broad knife*, which may be sharp on both edges, and introduced into a leather sheath made for the purpose. It will also serve to cut the branches of shrubs and trees.

2. A *Vasculum* or *Tin Box*, for the purpose of carrying plants. This should be of sufficient dimensions to hold full sized specimens. A proper sized vasculum should be from 17 to 20 inches long, 7 to 9 inches wide and about 5 inches deep, and convex on the sides, so as to give more room within. The lid should be of large size and well secured against accidental opening. Two loops may be placed on the lower surface to receive a strap, by means of which the box may be carried on the back or side. A vasculum of smaller size may also be carried for the purpose of receiving more delicate plants, Ferns, Mosses, &c.

3. A Botanical *Field Book* will always be found convenient to preserve plants with very delicate flowers or leaves. It consists of two boards, between which is placed a quantity of absorbent paper in folded sheets, forming from twelve to twenty-four layers. The plants are carefully placed between these layers of paper, and subjected to immediate pressure by means of leather straps attached to the boards. The field Book may be made of any size to suit the fancy of collector. An ordinary portfolio containing bibulous paper will answer equally well, provided a uniform pressure can be applied to the plants.

4. A *Pocket Lens* or small magnifying glass will sometimes be of use in examining the fruit of Ferns, Mosses, &c., as well as the very delicate fresh-water *Algæ* and microscopic *Fungi.* It should therefore be in every botanical traveller's pocket.

In collecting botanical specimens, it should be made a rule, that, as far as practicable, the entire plant should be taken with its root, stem, leaves and flowers. The specimen cannot be said to be perfect without the fruit and seed; hence, should these not be obtained when the plant is in full flower, they can be gathered at a later season. If the plant be too large to be taken entire, it will suffice to possess a flowering branch, the fruit and some well formed leaves. In this case, the collector should observe the

characters of the parts not taken, as the bark, roots, &c., and also notice the form and size of the plant, more especially if it be a shrub or tree. Another point to be attended to is the collection of more than one specimen of each species, which, after drying, will enable the botanist to make choice of the finest specimen for his herbarium and give him the advantage of having duplicates for exchange with other botanical collectors. As soon as gathered, the plants are to be carefully placed in the vasculum in such a way as to prevent injury to the flower and crushing of the leaves. If small and very delicate, and more especially, if the flower be tender and deciduous, they should be immediately pressed between the layers of bibulous paper in the Field Book or Portfolio, care being taken to arrange the parts so as to preserve the natural habit and appearance of the whole plant. Some plants may be gathered from different localities and any variations observed are to be noticed. Should this be done over extensive districts, the geographical range of distribution will in many instances be ascertained and will constitute a valuable desideratum in this country. Monstrosities, which are interesting in a morphological point of view, should likewise be preserved and the circumstances in which they were found, mentioned. In an excursion, notes may be taken of the general features of the country, scenery, &c., as these will be of much value for subsequent reference.

On returning from a botanical travel, it should be the object of the collector to name all the plants he has gathered and subject them to pressure immediately. It is much more easy to examine the characters of a plant when it is fresh, and the flower can be more readily dissected for the purpose of ascertaining the relations and dispositions of its parts, which are always referred to in botanical descriptions. We shall allude to the mode whereby the names of plants may be easily arrived at; but as this will require some general explanations regarding their natural classification, we shall leave the subject till our collection of plants is safely under pressure.

For the purpose of drying plants, it is necessary to have the following apparatus:—

I. *Absorbent Paper*, of good texture, and large size—say 18 inches long by 11 broad. This will answer all ordinary plants, but in the case where the flowers or leaves are delicate and cannot easily be transferred, it is advisable to place them first within a sheet of thin crown tea paper or fine blotting paper, from which

they are not to be removed till the second or third changing. There should always be a sufficient quantity of absorbent paper at hand for placing the plants newly collected, and for changing older collections in process of drying. As soon as the wet paper is removed, it should be hung up or spread out to dry, so as to be ready for use when required.

II. *Boards.* These are intended to be placed at certain intervals between the absorbent paper, say at a distance of two inches, in order to preserve a uniform pressure. They should be of the same size as the paper, and about $\frac{1}{3}$ of an inch in thickness. There should also be two boards, $\frac{3}{4}$ of an inch thick, to serve as strong outside boards—one underneath, the other above. Sheets of firm pasteboard are sometimes convenient for separating plants with stout woody stems from the more delicate ones, and thus preventing injury. They are also useful for packing up collections of dried plants temporarily.

III. A *Lens*, a small *Knife* or *Scissors*, and an ordinary *pair of Forceps*, should always be on the table for use when required. A sufficient number of small slips of paper should be cut for the purpose of writing down the Name of each plant, the Order to which it belongs, its Habitat or place where found, the Date of gathering, and any other remarks that may be considered worthy of notice—more especially in relation to deviations in form, size, locality of growth, &c., &c. These slips or labels should be placed beside the plants to which they refer.

IV. *Weights* are required to apply pressure to the plants after being arranged in the paper. If there be but one weight, it should be placed exactly upon the centre of the upper outside board, and should not be less than 100 pounds. It is preferable to have two or three different weights, so as to vary the amount of pressure from 60 to 120 pounds, according to the wet or dry state of the plants—those having been pressed for a week or so and more or less dry, not requiring so heavy a weight as previously. Some Botanists use screw-presses by which they are enabled to regulate the amount of pressure according to circumstances, but they are far from being so convenient as the ordinary weights.

Being thus furnished with the necessary apparatus, the collector adopts the following mode of pressing the plants and preparing them for the herbarium. One of the outside boards is placed upon the table immediately in front of him, and over it two sheets of absorbent paper. Upon this he spreads out one or more speci-

mens according to their size, and arranges the parts in such a manner as to preserve as much as possible the natural habit and appearance of the whole plant. Should the plant be too large for the paper, it is to be folded upon itself and the flexure may be retained by passing it through a slip of paper, slit half an inch more or less for the purpose. The label containing the name, &c., of the plant is then to be placed with it, and the whole is to be covered by four or six sheets of paper. In doing this gradually from below upwards, care should be taken that every part of the plant be well spread out. The right hand will effect this easily, with the assistance of the knife or forceps, if required. The next specimen or set is to be arranged upon this in the same way, and a similar number of sheets laid over it, repeating the process till it is thought necessary to insert a thin board in order to preserve uniform pressure. Other parcels of paper and specimens are arranged in like manner above it, and so on, till all the plants are prepared, when the second outside board is to be placed on the top, the whole removed to a safe corner and the necessary weight, as formerly mentioned, applied. The plants are to be transferred from wet to dry paper with the utmost care, using both hands and the forceps, when necessary. The first changing should be within twelve hours, and the second likewise after the first, as a general rule. For the following five or six days, a change every twenty-four hours will suffice, after which the interval may be extended more or less. A pressure of ten or fourteen days will effect the drying of most plants, and such as are properly dried should be removed and the remainder continued under pressure. Some succulent plants are very tenacious of life and will sprout even under great pressure. To prevent this, they must be immersed in boiling water for six or eight minutes, then dried with a towel and put between a double quantity of paper. The great point in drying plants is to effect the object as rapidly as possible, for then they are most likely to retain their natural appearance and colour.

A few other special directions, which have been omitted, may be mentioned here. For example, roots should be well washed and dried or otherwise cleaned before putting the plant in paper; bulbs, if large, should be slit in half or partially scooped out; large dry fruits may be wrapped in paper with the name of the plant to which they belong, and afterwards placed with them in the herbarium while large succulent fruits may be preserved in

wide-mouthed, glass-stoppered bottles, containing alcohol, or a strong solution of salt and water, or pyroligneous acid diluted with little more than one-half of water. It is likewise advisable to preserve seeds in separate parcels of paper, to prevent their being scattered or lost. As soon as the specimens are thoroughly dried, they should be removed and either prepared at once for the herbarium, or placed in sheets of smooth thin paper, with name, &c., and temporarily stowed away, till a more convenient time permit their proper arrangement. The Botanist should make choice of the best and most perfect specimens for his own herbarium, and the remaining plants should always be carefully preserved for the purposes of exchanges, donations, &c. He will be frequently called upon by other collectors, and his botanical generosity will always prove as much a source of gratification to himself as to the recipient of his favors. Nor is it a lost gift, as ere long he is doubly paid by the bounty of him whom he once befriended.

In forming a herbarium, it is necessary to place the plants either in stiff portfolios or volumes, which may be numbered, or in wooden cases or boxes, say 4 inches deep, with a double lid, one on the top and the other on the front side. If the collection, however, is likely to become large, it is preferable to get a cabinet made specially for the purpose, having folding doors and containing sliding drawers or trays, whose measurement should be as follows: length 19 inches, breadth 11½ inches, and depth 4 inches. The trays may number twenty or twenty-four, disposed in two rows, but the size of the cabinet depends on the collector himself who is better able to judge of his requirements.

Having wherein to place his plants, he now prepares them finally for preservation. For this purpose, he must have a quantity of good thick white paper, cut in single sheets, and measuring 17 inches in length and 10½ inches in width.* In all herbaria, the plants should be fastened to the paper by white thread or, what is better, by means of thin fine glue, or a solution of gum Arabic and gum Tragacanth in a sufficiency of water. The mode of procedure is as follows: The operator places a sheet of paper in front of him and lays the plant to be fastened to it upon a newspaper on his left side, with its upper surface undermost. The glue is then applied carefully to its under surface by means of a

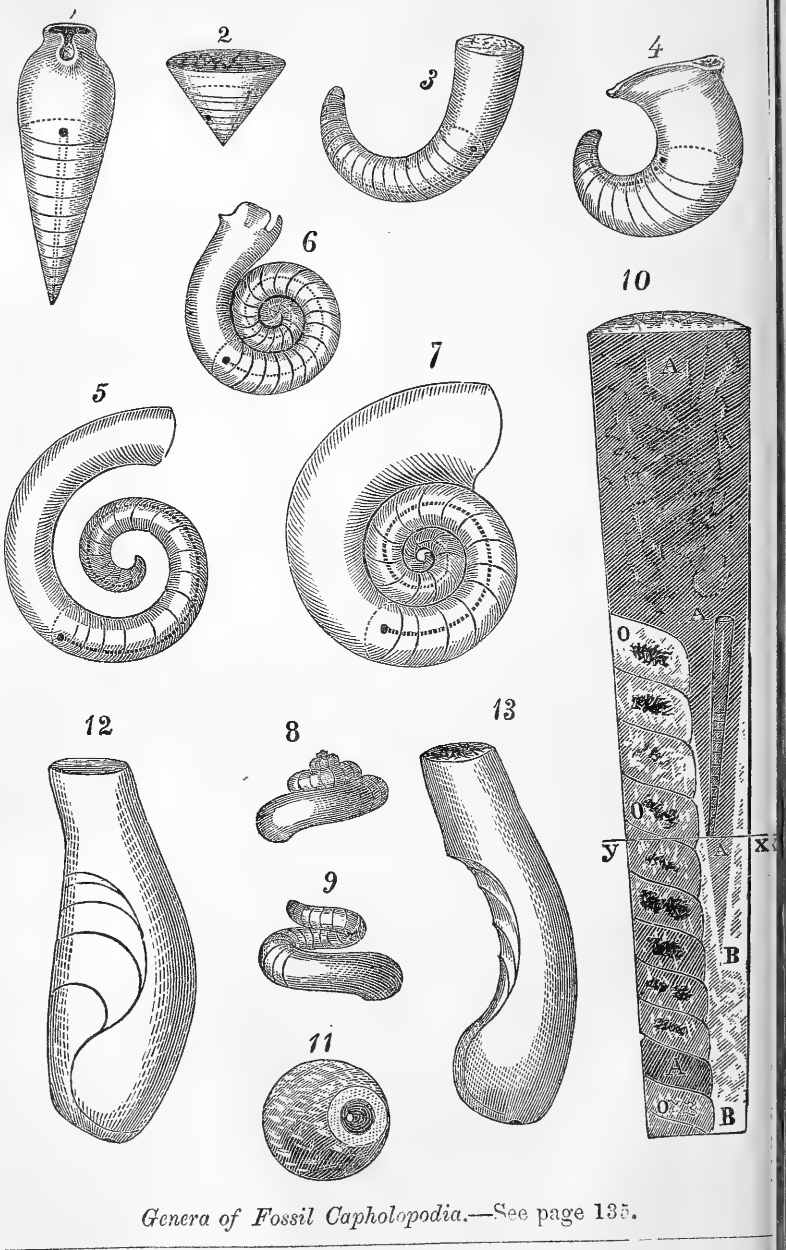
* The best paper of the kind is that sold by Messrs. Weir & Dunn, of this city, under the name of B. Laid Medium 34 lbs, flat (Mill 60.)

camel's hair pencil, immediately after which, the plant is to be lifted and turned by the fingers or forceps and transferred to the sheet of paper upon which the root, stem, leaves and flowers are to be slightly pressed. Two or even three specimens of the same species may be placed on the sheet, provided there be sufficient room. The name of the plant is then to be neatly written at the bottom of the sheet, generally on the right hand side, with its locality or habitat, date of collecting, and other particulars if worthy of notice. As soon as this is done, the specimen is to be put under a slight and uniform pressure for an hour or two and afterwards removed to its proper place in the cabinet. The other specimens are to be prepared in the same way, and should the stems be strong and thick, they may be more firmly secured by narrow strips of gummed paper, laid transversely across. In order to preserve the specimens from the attacks of insects, they may be lightly touched with a solution of corrosive sublimate in camporated spirit, say half a drachm to the ounce.

In placing the plants in the herbarium, all the species of a genus should be put together, and each genus should be marked and separated by a single sheet of firm coloured paper of fine texture. If they be arranged according to the Natural System, which is the best mode of classification, the plants included in each order should be inserted within a sheet of larger and stiffer paper, as cartridge paper, to which the name of the order is attached so as to be readily seen when reference requires to be made to it. The Natural Orders should likewise be arranged according to an approved system. The only other points of importance regarding the herbarium are, that it should be well secured under lock and key and put in a safe and dry place, and the trays subjected to an occasional airing to prevent the adhering of moisture to the paper, and thus preserving the specimens from becoming mouldy.

We now offer a few remarks in reference to the naming of plants. This may be either a task of some difficulty or one of great ease to the young botanist, according to his knowledge of the structure and anatomy of the various parts of plants, and the means he may adopt to discover their names. If previously unacquainted with botanical science, he should gradually make himself familiar with the plant, more especially the flower and the different forms of roots and leaves—the various terms applied being studied through means of a glossary. The flower requires special attention, because it may be said to form the basis of clas-

PLATE II.



Genera of Fossil Capholopodia.—See page 135.

sification, and is constantly referred to in the descriptions of plants. It should be studied in all its stages of development from the bud to the mature fruit. The accomplishment of this will be found easy, if the flowers of different plants be taken one after the other, and their various parts carefully dissected, so as to observe their number, form, position, and the relations they bear to each other.

We have not space here to enter into the details of naming and classifying plants, and we consider it in a great measure unnecessary, inasmuch as we can refer the student to the elaborate and very simplified directions upon the subject in "*Gray's Lessons on Botany*," a work which cannot be too strongly recommended for general use, from the ability with which the author has succeeded in popularising the Science of Botany and rendering its study easy and interesting. It has the advantage also of containing a copious Glossary or Dictionary of Botanical Terms, to which reference can be made when required. The observations which bear upon the naming and classifying of plants will be found in Lessons XXVIII to XXXII included, extending from the 173rd to 199th page. The ample illustrations there given will, if carefully studied, impart to the young student sufficient knowledge to enable him to discover the names of other plants in like manner. It will be observed that Professor Gray adopts an Artificial Key to the Natural Orders, and it may be mentioned that this is by far the easiest method of determining the names of plants. The Artificial Key will be found at the beginning of his "Manual of the Botany of the Northern United States,"* which should be in the hands of every botanical collector in Canada, as it is the only modern work which describes the plants that grow in this Province in common with the Northern States, and of these there are a vast number.

J. B.

ARTICLE XVII.—*On the Genera of Fossil Cephalopoda occurring in Canada.* See plate II.

In a former number of this Journal (See Vol. 1, page 315,) some account was given of the Orthoceratites, and we shall here resume the subject by a general description of other groups, the remains of which either have been found or are likely to be

* Gray's "Lessons on Botany" and "Manual of Botany" may be had from B. Dawson, Bookseller, Great St. James-street, Montreal.

found in Canada. The typical form of the shell of animals of this division is a hollow cone, divided into numerous compartments by transverse partitions called septa, which are penetrated and connected together by another hollow cylinder or tube called the siphon or siphuncle. Starting with this idea we have the following modifications of the shell in the different genera:

1. *Orthoceras.*—In this genus the shell is straight, the transverse section either circular, oval or more or less triangular, and the siphon either central, marginal, or between the margin and the centre. Fig. 2, represents a short very rapidly tapering form. The species as yet discovered in this country are all long and very gradually tapering.

2. *Cyrtoceras.*—This genus is the same as the former, but is curved, and the siphuncle is in the greater number of species situated near the margin on the side of the convex curvature as shewn by the dotted line in fig. 3. It is sometimes, however, central or even near the other or concave side.

3. *Nautilus.*—Same as Cyrtoceras, but so closely coiled that the whorls are all in contact, Fig. 7. In these three genera it will be observed that the form of the aperture is the same as the tranverse section of the tube, but in the next four it is not.

4. *Gomphoceras.*—Straight, the same as Orthoceras, but with the aperture contracted in the middle so as to consist of two lobes. The position of the siphon is equally variable with Orthoceras. Fig. 1.

5. *Phragmoceras.*—Fig. 4. Same as Gomphoceras, but with the shell curved. The siphon is usually on the inside, but species have been found with it differently situated.

6. *Lituites.*—This genus has the contracted aperture of the last two; a portion of the shell is closely coiled and the remainder free and straight. Fig. 6.

7. *Gyroceras.*—Fig. 5, represents one form of this remarkable genus. The shell has no straight portion, and in some of the species it is closely coiled as in Nautilus. The siphuncle in the species as yet described is between the centre and the outside. The aperture has been detected in some species found in Bohemia, and is thus described by M. Barrande. In noticing *G. mirum*, a species whose surface is decorated with spines arranged in rows, he says: "It is not, however, on account of the ornament that I have named this species as above; but the mouth of the shell appears to me very wonderful, being neither round nor elliptical,

as in other allied forms, but half-closed by the bending back of the shell upon itself. Looking at the mouth of this shell, one might think that for half its extent it had been closed by a septum, the direction of which is symmetrical and inverse to that taken by the septum of the body chamber. On first examining these specimens, I was inclined to think that half the aperture was closed by a loosened septum; but further observations in eight or ten individuals shewed that it could not be an accidental condition, and lastly I found a specimen in which the whole circumference of the mouth could be traced with certainty. This semiclosure of the orifice of the shell in Gyroceras, appears, therefore, to be analogous to the contraction of the mouth in Pragmoceras, Gomphoceras and Lituites, above mentioned; but is peculiar in this, that it is not the lateral margins that are bent towards each other, as in these genera, but only the inner (under) margin is pressed back, (*Journal of the Geological Society, Vol.* 10, *p.* 23, *of Miscellanies.*)

8. *Trochoceras.*—Figs. 8 and 9 represent two forms of this genus, the tube is coiled with a double curve like that of a snail, and the whorls are either in contact as in Fig 8, or separate as in Fig. 9.

9. *Ascoceras.*—In this genus that portion of the shell which contains the air chambers, appears to be turned upwards, and recessed into one side of the body chambers. A small portion of it only remains at the bottom as seen at the base of Fig. 12. The siphon in specimens denuded of the shell can also be seen at the base. This genus has been recently discovered in the lower Silurian Rocks of this country, by Mr. Richardson, of the Geological Survey of Canada.

Fig. 10, is a longitudinal section of an Orthoceras with a large marginal siphuncle. The spaces marked with the letter O, are the air chambers. A A A the large chamber of habitation which according to the views of M. Barrande, the distinguished palæontologist of Bohemia, extended into the siphuncle. In the lower part of the siphuncle is a space marked B of a lighter colour. M. Barrande is of opinion that certain species of this genus secreted a calcareous matter in the siphon which at length partially filled the tube. The letters B B indicate the position of this deposit in the specimen figured which is the *Orthoceras communis* of Europe. Professor Hall considers the Orthoceratites of the Trenton limestone, with these large marginal siphons to be gene-

rically different from Orthoceras proper, and has accordingly constituted a new genus *Endoceras*, for their reception. Another genus quite common in the Black River limestone of Canada, is *Gonioceras*, (Hall.) But a single species is known (*Gonioceras anceps*,) and it is remarkable for its form, almost flat like a two edged sword. We shall give figures of this and other species in a future article.

There are many species of Orthoceras in the Silurian Rocks of Canada, not yet named, and owing to the close resemblance of some of these, and also to the fact that they generally occur in mere fragrents, it is most difficult to identify them, or to decide whether they are new species or not. It will probably be many years before materials will be collected to complete this part of the Ancient Natural History of the Province, and we would therefore earnestly recommend all public Institutions in their exchanges not to part with any of their Orthoceratites, for it is only by combining the light afforded by all the collections that the Cephalopoda of the Silurian Rocks of Canada can be worked out. It is also very desirable that gentlemen in possession of these relics should publish short descriptions of their specimens, in one of the scientific journals of the Province. This remark applies to every other department of Natural History. In fact, there is not one single species either recent or extinct concerning which, there is not yet much to be made known. Every little fact, therefore, no matter how unimportant it may appear at the time to the observer, is to a greater or less extent of value, and should be communicated for publication.

Fig. 11, is a transverse section of the specimen represented by Fig. 10, at the line from Y to X. It shews the siphuncle with the thickness of the calacerous secretion upon the inner surface. A small Orthoceras is shewn in the siphon of Fig. 10, into which it had found its way after the death of the larger individual.

The figures have all been copied from the Bulletin of the Geological Society of France, of January, 1855.

ARTICLE XVIII.—*Notes on the Land Birds observed round Montreal during the winter of* 1856-7, *by* W. S. M. D'Urban.

The late winter having been one of a very remarkable character, whether we consider the severity of some portions, or the unusual mildness of others, I am induced to offer for insertion in the

[illegible]

[illegible] ... of limestone and [illegible] ... species is known. [illegible] ... for its [illegible], almost [illegible] ... give figures of this and [illegible] species in [illegible].

[illegible] ... Orthoceras in the Silurian Rocks of [illegible] ... close resemblance of [illegible] ... they generally occur in [illegible] ... them, or to decide whether [illegible] ... probably be many years [illegible] ... this part of the [illegible] ... would therefore [illegible] ... their exchange [illegible] ... it is only by [illegible] ... light afforded [illegible] ... Cephalopoda [illegible] Silurian Rocks [illegible] ... be made out. [illegible] ... relics should [illegible] ... in one of the scientific journals of the Province. This [illegible] applies to every other department of Natural History. In fact, there is not one single [illegible] ... concerning which, there is not [illegible] ... known. [illegible] the fact, therefore, no matter how [illegible] ... is to [illegible] ... ed the [illegible].

Fig. [illegible] ... by Mr. [illegible] ... from Y to Z [illegible] ... with the thickness of the calcareous [illegible] ... upon the inner surface. A small Orthoceras is shown in the [illegible] of Fig. 10, into which it had found its way [illegible] ... larger individual.

The figures [illegible] ... the Bulletin of the Geological Society [illegible].

[illegible]

[illegible] Naturalists [illegible]

[illegible]

[illegible] Bald Eagle, Pigeon Hawk [illegible] Owl [illegible] Tree Sparrow [illegible] Jay, Red-Tailed [illegible] Quail, [illegible] Grouse, were [illegible] observed by me near [illegible] during the [illegible] months. [illegible]

[illegible]

[illegible] I wounded one of this [illegible] 19th, 1886. It was sitting in a tree in an open field by the [illegible] of the Mile-End Road Lane ~~though~~ the sun was shining [illegible] did not appear to be at all inconvenienced by the bright light [illegible] restless [illegible] changing its place, and often dropping down from the tree to the ground and flying up again. [illegible] flew off before I could get [illegible] and in [illegible] of me. Not wishing to lose a chance, [illegible] without [illegible] saw it, and after some trouble I obtained a [illegible] and wounded it. Although much hurt in its wing and body it flew across a field [illegible] I could secure it. I placed my gun upon it as it lay on the ground and [illegible] attempt [illegible] when it [illegible] fiercely [illegible] my hand. Its flight was low and [illegible] that of a [illegible] not [illegible] mistaken [illegible]

Canadian Naturalist and Geologist, a few remarks on the Land Birds observed by me, in my ornithological rambles in the immediate neighbourhood of Montreal, from November 1st to March 31st, and which I hope may not be found altogether uninteresting.

I have mentioned three species, viz: the *Robin*, *Snow bird* and *American Shrike*, which can hardly be considered as winter residents here, but are noticed because stragglers remained for some time after the cold weather had set in. The total number of species which wintered round Montreal exclusive of these three, is 15. The number mentioned as wintering in the neighbourhood of Toronto in a paper by G. W. Allan, Esq., published in the "Canadian Journal," for March 1853, is 24. Of these the following twelve, viz: Bald Eagle, Pigeon Hawk, Great Horned Owl, Little Horned Owl, Goldfinch, Tree Sparrow, Common Crossbill, Canada Jay, Red Bellied Nuthatch, Hairy Woodpecker, Quail, Canada Grouse, were not observed by me near Montreal during the winter months. Two species which wintered here, viz: Hawk Owl and Brown-creeper, are not mentioned as occurring about Toronto. Observations extending over several years would doubtless add considerably to the number of species which pass the winter in the neighbourhood of Montreal.

In the following notes I have adhered to the nomenclature and arrangement adopted in Audubon's Synopsis of the Birds of North America.

Surnia funerea—Gmel.—Hawk Owl. I met with one of this owl November 19th, 1856. It was sitting in a tree in an open field by the side of the Mile-End Road, and though the sun was shining brightly, did not appear to be at all inconvenienced by the bright light. It was shy and restless, frequently changing its place, and often dropping down from the tree to the ground and flying up again. It flew off before I could get within shot and crossed the road in front of me. Not wishing to lose a chance, I fired, but without success, being too far off. Before I could reload, it again crossed the road and pitched in a tree near were I first saw it, and after some trouble I obtained a shot and wounded it. Although much hurt in its wing and body it flew across a field before I could secure it. I placed my gun upon it as it lay on the gound and it remained quite motionless till I attempted to kill it when it fought fiercely and struck its claws into my hand. Its flight was low and had great resemblance to that of a Hawk, for which I at first mistook it. Its stomach contained the fur of

mice. I received another specimen from Laprairie which was shot in December. On 27th February, about sunset, I saw one sitting on the top of a tree in a small wood also near Mile-End road, and was just about to fire at it, when a hare ran past me which I shot. The report of the gun frightened the Owl and it flew away and I lost sight of it. Presently, however, seeing a large flock of Crows pitched on some trees about half a mile off I went towards them and found them mobbing the Owl which was sitting motionless in the top of a very high tree. I fired at it, and though apparently struck by the shot, it took no notice beyond shaking itself and turning its head to look down at me. I then gave it another shot and it fell half way down the tree, but recovering itself flew away and disappeared behind some bushes.

Although this bird has somewhat the appearance of a Hawk, yet there is no Owl with which I am acquainted in which the formation of the breast-bone and merry thought differs so much from that which obtains amongst the Falconidæ. The *sternum* is very weak and the *forked-bone*, consists of two separate pieces, only united at their apices by a slight cartilage, I am not aware that this fact has been previously noticed by ornithologists, and I can find no mention made of it in the works of Wilson, Audubon, Richardson or Yarrel.

Surnia nyctea. Linn. Snowy Owl. I saw only one of this Owl alive during the winter. On 17th January, one of the coldest days of the season, I walked across the ice to Nun's Island, and saw a Snowy Owl sitting on an isolated branch of a tree, near the farm yard attached to the Convent. It was so very shy I could not get near it. I visited the island several times afterwards in hopes of obtaining a fair shot at it, but was always unsuccessful, and it disappeared when the mild weather set in about 6th February. When I reached the island it was invariably exactly in the same spot, looking like a lump of snow in the tree, but whenever I attempted to get within shot; it would fly off and pitch on a fence, always shifting its place as I approached. The whiteness of its plumage rendered it very difficult to be seen when flying over the snow, and one day it flew past me without my seeing it till close to me, and was out of shot before I could draw off my mit to pull the trigger. Once I tried the expedient of putting a white shirt over my clothes, unfortunately, a friend with me not made similarly invisible, frightened it off before I got within shot. It probably subsisted on the rats in the farm yard,

or perhaps on the snow buntings, large flocks of which were always feeding there. At the end of January, I was shown a specimen said to have been shot near Montreal a few days before I saw it.

Syrnium nebulosum. Linn. Barred Owl. I shot a specimen of this species on 21st January. It was sitting in a tree in a small wood on Nun's Island and was very tame and stupid. It had some animal like a small rat almost whole in its stomach and was the fattest bird I ever skinned, the entire body being covered with a thick coating of hard white fat. Another specimen was killed on St. Helen's Island in January, and several others were exposed for sale in the markets.

Certhia familiaris. Linn., Brown Creeper. This little bird was numerous on the 6th February in the woods on Nun's Island, flying from tree to tree in company with the black-capt tits and nuthatches. I shot several specimens. The weather at the time was extremely mild.

Parus atricapillus. Linn. Black cap Tit. Very numerous every where round Montreal throughout the winter.

Turdus migratorius. Linn., Robin. One shot November 6th in a swamp near Monklands. I saw a bird which I thought was a robin in December and another at the beginning of January.*

Plectrophanes nivalis. Linn., Snow Bunting. Very abundant. In January large flocks were always to be seen feeding in the farm-yard on Nun's Island. When alarmed they would fly up and pitch in a long row on the ridge of the roof of the farm buildings, alighting again as soon as the danger was past. One specimen which I shot there had its crop full of the sprouted seeds of onions or leeks, and its whole body partook of their odour. In others, shot at the same time, I found grains of wheat and some small seeds. They also feed much on the seeds of a species of Euphorbia when the snow is not too deep. Their white bodies and black wings give them a very curious and peculiar appearance when seen against a clear winter sky.

Niphœa hyemalis. Linn. Common snow-bird. This species continued abundant up to the second week in November, after which I lost sight of them.†

Linaria minor. Ray, Lesser red poll. First observed 24th November, but not numerous till beginning of February, when immense flocks appeared in the neighbourhood and continued

* Spring arrival, 13th April, 1857.

† Spring arrival, 5th April, 1857.

here till middle of April. A great number were in very handsome plumage, and some small flocks consisted entirely of males with red breasts, whilst in others, all were destitute of the red on the lower parts, but I met with flocks towards the end of the winter consisting indiscriminately of males and females. Hundreds were exposed for sale in the markets, and appeared to have been taken by means of nets or traps, as they had all been killed by crushing the skull, and none exhibited any shot marks. These large flocks fed on the seeds of the birch and alder, but principally on those of thistles, &c., not covered by the snow and must have been of great service in reducing the progeny of those noxious weeds. The Canadian farmers however, who are themselves too indolent to rid their farms of the weeds which are so injurious to their crops, for the sake of gaining a few coppers, destroy without mercy these useful and harmless birds,—the means which a wise providence has provided for checking the increase of those troublesome plants which on some of the Canadian farms threaten to entirely usurp the place of the crops.

Linaria pinus, Wils. Pine Linnet, I met with only one small flock which was feeding on an alder tree in a swamp near Mile-end Road, November 20th, 1856, and of which I shot two specimens.

Corythus enucleator, Linn, Common Pine Finch or Pine Grosbeak. The first time I observed a flock of this fine bird sufficiently close to identify, was on the 6th January, but I saw some birds at the beginning of December, which I could not distinguish, but which were very probably of this species. When I first saw them they were feeding on the berries of the Mountain Ash in company with a large flock of Waxwings as noticed in the "Canadian Naturalist and Geologist" for February, page There cannot be a greater contrast than exists in the manner of feeding and internal formation of these two birds which subsist on the same berries. The Grosbeak with its strong bill and hard muscular stomach, discards the skins of the berries, swallowing nothing but the pulp and pips or seeds, which are ground to pieces by the action of the gizzard aided by small stones which I found in all I opened. The Pips thus crushed communicate a strong odour of Prusic acid to the whole body. The pulp seems to be very easily digested as although always present in the throat and crop, I could never detect it in the true stomach. The Waxwing on the contrary having a comparatively weak bill, capacious throat,

and soft membranaceous stomach, swallows the berries whole and unbroken, and the pips pass out of its body without having undergone any change by the process of digestion and imparts no smell to the flesh, the fruity portion only being retained for the nourishment of the bird. At first sight it would appear as though the strong bill of the Pine Grosbeak was not needed in opening such soft berries as those of the Mountain Ash and Cranberry on which they principally feed in winter, but when the thermometer is many degrees below Zero the berries are frozen as hard as stones, and it must require great force to crush them. This species was most numerous at the end of February and beginning of March, when very large flocks were constantly feeding in every garden in Montreal where there were any berries to be obtained and they were extremely tame rendering it difficult to avoid blowing them to pieces by discharging the gun too close to them. I did not see any after 11th March, so I suppose they must have left about that time. These flocks consisted almost entirely of dull coloured individuals, females and young birds, and I saw but two or three old males in their handsome red plumage.

Corvus Americanus—Aud.—American Crow. Plentiful up to 10th December, only a few seen in January and beginning of February—became abundant at the end of February and extremely numerous at end of March. They subsisted on such scattered grain as they could find amongst the stubble in such fields as became bare of snow during the frequent thaws.

Garrulus cristatus—Linn.—Blue Jay. I was given a specimen shot on 25th November, near Mile-end Road. Its stomach contained a little fur and the lower incisor of a mouse. I did not see any myself during the winter months, but I am told they were common at Cote des Neiges feeding on Mountain Ash berries &c. This is not unlikely, as I am aware they winter at Sorel.

Lanius Borealis—Vieill.—Great American Shrike. I shot the first specimen of this species on 11th October, on the common near Mile end road. Its stomach was filled with the black field-crickets so abundant in this country. I met with several other examples in October and November, and the stomach of one shot on 20th November contained the fur of mice. The smaller Rodentia appear to constitute the staple article of food of a great many birds in the winter season. I saw the last Shrike on 2nd of December when the ground was covered with snow. All I saw were sitting on the topmost branch of a tree or bush. This

bird when wounded is extremely bold and fierce, giving very hard blows with its powerful bill. *

Bombycilla garrula—Vieill.—Black throated Waxwing or Bohemian chatterer. This was the most abundant bird round Montreal during the winter. From the beginning of January to the 22nd April, large flocks were constantly flying round the city frequently feeding in the gardens even in the very heart of the town. They were however much more shy than the Pine Grosbeaks, readily taking alarm, and were often difficult to approach. Comparatively only a small portion were in really handsome plumage, many specimens being entirely destitute of the waxlike prolongations of the shafts of the quill feathers and the yellow band across the wings, and having nothing but a narrow white stripe on the wing feathers. I obtained specimens showing every gradation from the bird of last year to the full plumaged male. The mature females are nearly as handsome as the males. The ovarium and eggs of an old female dissected by me on 22nd April, were still very small. They fed on the berries of the Mountain Ash and Cranberry, at first, and when these failed on the dried fruit of the common Thorn. It was a remarkable thing to see this species feeding on the same trees frequented by its almost sole congener the Cedar bird in the autumn. The one exclusively a winter visitor the other as strictly a summer bird of passage. I have not seen any more of this bird since the last heavy fall of snow on 27th April.

Sitta-Carolinensis—Linn.—White breasted Nuthatch. I shot one specimen on 19th November, and saw several in the woods on Nun's Island, on 6th February.

Picus pubescens—Linn.—Downy Woodpecker. Tolerably plentiful throughout the winter. Rather numerous in the woods at Nun's Island in January. Capt. Macdonald, A. A. G., showed me a remarkable variety which he shot there on 16th January. It was a male and had a large olive coloured patch on the wing coverts of each wing.

Tetrao umbellus—Linn. Rather numerous all through the winter on the Mountain, and in the swamps near the mile-end road. It is curious to see the tracks of this bird on the snow, round every small bush it has come to, and of which it has nipped off all the buds it could reach.

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* Spring arrival, April 13th.

Besides the above species it is very probable that several escaped observation. I received a specimen of the Gos-Hawk, Astur palmnbarius, shot near Laprairie at the end of December or beginning of January. It is not unlikely that several species of Hawks occurred here at the beginning of the winter, which I did not observe. An announcement appeared in the Montreal papers at the end of February, to the effect that a yellow bird (or Goldfinch) and a Rossignot (or Song Sparrow) had been lately seen at Cote des Nieges. What reliance is to be placed on this statement, I am unable to say. The weather at the time was so mild that it seems not improbable there may be some truth in this and other reports of the kind, which came to my knowledge. I will conclude these very rough and hasty notes by expressing the hope, that they may be the means of eliciting further and more valuable information on the birds of this and other parts of Canada, from observers with abler pens than my own, for the "Naturalist," and should such be the case, any trouble they may have cost me will be most amply repaid.

W. S. M. D'URBAN.

Montreal, 13th May, 1857.

ARTICLE XIX.—*Notes on the Bermudas and their Natural History*, with special reference to their *Marine Algæ*, by the Rev. ALEX. F. KEMP; read before the Botanical Society of Montreal.

The small group of Islands called the "Bermudas," or the "Somers Islands," make up together a "miniature Archipellago," on the western side of the Atlantic Ocean, in lat. 32° 15′ North, and long. 64° 51′ West, about 600 miles from Cape Hatteras, in North Carolina. They are alone amidst the waste of waters, as solitary sentinels at the most northerly outposts of the West Indian group. It is said that they number as many islands as there are days in the year, and perhaps were every little rock which lifts its head above the water and is adorned with a sage bush or a cedar tree to be counted, this might be true; but there are not more than from twelve to twenty islands which properly deserve to be designated as such. The four principal of these are, the Main Island, or Bermuda proper, which is about 15 miles long,

in a direction nearly S. W. and N. E, and on which Hamilton the chief Town of the Islands and the Seat of Government is situated; St. George's, about 3½ miles long, on which is a Town of the same name, Garrisons, and the head-quarters of the Military; Somerset, 3 miles, united by a bridge to the main-land; Ireland's Island, 1½ miles long. The others which are of any importance lie chiefly on the southern side of the group, at its north-eastern extremity. The whole islands are thus not more than 25 miles long by from 2 miles to a few yards, in some parts, broad. The land has the appearance from the sea of a range of low undulated hills, none of which rise to a higher elevation than 250 feet.

The geological formation of this group is somewhat peculiar. The lower strata of which it is composed, and upon which it has been built, is a hard calcareous sandstone. It is exposed chiefly on the south side of the main island at low water mark, and, in situ, it lies in an almost horizontal position. By the force of the swell which rolls in from the South, sometimes with fearful violence, large masses of this rock are torn from their beds, broken into fragments, and heaped up in distorted forms. The mass of rock superimposed upon this base is composed of what may be termed a corallinaceous sandstone of different degrees of induration and of fineness. Some parts, by reason of exposure to the atmosphere and other causes, have become extremely hard, and have resisted the action of the elements apparently for ages. This formation has a curiously twisted and irregular stratification, or rather it can scarcely be said to have any proper stratification at all. The section it is true presents us with lines of rock running through it at all angles of inclination and assuming the most fantastic appearances; but these give no sure index of the time of their deposition, but rather reveal the chemical processes by which the mass of calcareous sand has become gradually cemented and indurated. There does not appear to be any distinct evidences in any part of the islands of volcanic action or of violent disturbances of nature. All that can be said is, that there may at one time have been a subsidence of the land and a considerable denudation and erosion of its rocks, with perhaps a subsequent elevation to some extent. Land-shells of the genus Helix are found embedded in the rock now covered by the sea at high water, and there are appearances of sea beaches considerably above the present rise of the tide; but these movements have apparently been effected

during the lapse of ages, without any disturbance or fracture of the rock formations.

This land thus superimposed on the limestone rock of the Tertiary period has evidently been formed by the combined action of the sea and the wind—the sea eroding the Polypi corals, grinding their fragments into sand, and washing them up on the beach; and the strong winds which characterize the latitude of these islands drives with great force and to some distance the sands of the shore upon the higher lands. The sand thus forms great drifts, just as the snow does in our Canadian winter, and becoming cemented by some kind of chemical action, which may be witnessed in process at the present day, it gradually hardens into a granulated porous rock.

This being the general geological character of the Bermudas, it may be supposed that there will be found around their coasts numerous bays and estuaries; being also of coral origin, it may be expected that they will present more or less the appearance of the Lagoons so common to the coral islands of the Pacific. It is well known that the Polypi, or coral animals, when floating free, attach themselves to any obstruction that lies in their path, and that around this they deposit their limey secretions; and these gradually accumulating and rising in the course of unnumbered generations, take the form of a ring or belt, more or less perfect, according to the form of the obstructing rock. Most of the reefs that are yet covered with water have this appearance, and rise frequently from a great depth, like a forest of calcarous trees in the sea. According to this principle of coralline life, we find the whole group of islands partaking of this general circular character; and, including the reefs which stretch out under water a distance of about 10 miles, the whole gronp assumes the form of an egg-shaped oval, which again we find divided into greater and lesser circles. In the south-west there is the Great Sound, a circular basin of water, with openings narrow and intricate to the north and west, and attached to it there are several smaller basins or harbours of the same general form. To the east of this there is Harrington Sound, a beautiful sheet of water about 2 miles in breadth, forming an almost complete circle, and very deep, with but a narrow entrance on the north side—so narrow indeed as not to admit of the full rise and fall of the tide within the Sound. To the north-east of this again there are Castle Harbour and Saint George's Harbour, connected with each other by a narrow strait. These harbours have several

outlets to the north, the east, and the south; together they are about 3½ miles in diameter, aud are each of them of a somewhat circular form. They are studded with innumerable islets, and the great number of shoals and reefs with which they are filled renders their navigation, as we sometimes found to our cost, a matter of some difficulty and requiring much skill. In the nooks, corners and bays formed by this extremely varied arrangement of land and water, to which the instincts and habits of the Polypi have given their peculiar and typical form, and in the salt marshes and little lakes which are formed in the valleys, we find the habitats of a great variety of most interesting Marine Fauna and Flora —a perfect paradise, in which an earnest Naturalist may luxuriate.

The climate of the Bermudas, from their position, may be termed sub-tropical. The Thermometer iu winter seldom falls below 56° Fah.—on a cool evening it may fall to 52°. In the summer months it ranges from 68° to about 90°. The atmosphere is at all times very humid, and frequently disagreeably so. Spring aud Autumn are most paradaisical seasons in Bermuda. The heavens, the earth and the sea then appear in their most gorgeous robes, and from the highest peak of the land, as from a noble and beautiful pedestal, they may be surveyed in every direction stretched out in all their solemn grandeur. In the flora of such a climate it may be expected that we shall find the productions of both the temperate and the tropical zones. Vegetation puts on here a decidedly Oriental garb. The beautiful fan-shaped Palmetto, the gracefully luxuriant Banana, the bright blood-red Pomegranate, the deep-green umbrageous Fig, the Orange and the Lemon with their perfumed flowers and luscious fruit, the familiar Grape Vine, and the Oleander, the ornament of every garden, at once strike the eye. Besides these there are the Cedar, (Juniper Verginiana) which covers the islands with its dark ever-green foliage, and the sage bush with its tiny waxen flowers and pleasant odor—the most prolific of weeds and the plague of the farmer. There are also a great abundance of Cacti among which we have seen the magnificent night-blooming Grandiflorus. Several fine species of Acacia and the curious fruit-bearing, reticulate-branched Calabash, also the pride of India—a deciduous tree famous for its summer shade—the wrinkled Pawpaw and the graceful Coffee plant with its pretty flowers, all indigenous to the tropics, grow and flourish here. In the kitchen garden, melon, pumpkin, squash and cucumber vines, with tomatoes and sweet potatos, &c., grow in

great luxuriance. Of the temperate products the cereals hold an inconspicuous place. Formerly barley was much cultivated; now scarcely a patch is any where to be seen. Flour, the staple of life, is imported entirely from the United States. Formerly the chief wealth of a Bermudian planter consisted in his Cedar trees which were cared for and guarded with religious reverence. Now this kind of product is worth very little. It is only valuable for house and ship-building purposes on the islands, the export is now comparatively trifling. The result of this revolntion is that the land fit for cultivation is being gradually cleared, and the potato, the onion, and Indian Corn, together with the world-famons Arrow-root, are taking the place of the Cedar, and now constitute the chief wealth of the Bermudas. There is an annual spring exportation of potatoes, tomatoes, and onions to the United States of many thousand pounds value. Under proper management, with a little more enterprise and outlay of capital, these islands might also send to the States' market large quantities of sweet and bitter oranges, figs and grapes of the best quality, peaches, and even olives; but at present little or no care is taken in the cultivation of these fruits, and as they are exposed to so many hazards from which it requires skill and care to preserve them, they are for the most part neglected.

The land Fanna of these islands is comparatively limited, there being no permanently running fresh water streams; and with the exception of rats, mice, and a few rabbits, there are no quadrupeds worth noting. The only noxious animal that is found here is the Centipede, large individuals of which are frequently seen in old and damp houses. There are moths, butterflies, fire-flies and coleoptera in great abundance. The air in summer is vocal with the voice of the Cicadae. Cockroaches, millepedes, spiders, ants, mosquitos, fleas, (Pulex iritans and P. penetrans, or the chigœ,) abound and are somewhat troublesome. The Entomologist may find here a rich field for investigation. A great variety of birds are to be met with in Bermuda. A list of eighty-three has been compiled, but most of them are but transient visitors. A few winter on the islands; the usual residents are few. With the exception of two accidental stragglers which have been seen from the eastern hemisphere, viz: The Wheatear (Saxicola Aenanthe) and the Corn Crake, (Crex Pratensis,) all the others are common to North America. The constant residents are the Sylvia sialis or Blue Bird; the Orpheus Carolinensis, or Black Bird; the Pitylus Cardinalus, or

Red Bird; the Vireo Noveboracensis, or Chick of the Village; the Corvus Americanus, or American Crow; the Gallinula Chloroporus, or Common Moorhen; the Perdix Virginianus, or Virginia Quail, nearly extinct. It was abundant formerly when barley was more cultivated, but now it is probably a bird of passage. The summer residents are, the Phæton Aetherius, or Longtail; the Sterna Dougallii, or Roseate Tern, and the S. Anglica, or Marsh Tern. There are, besides these, a large number of autumnal and winter visitants, some of which revisit the islands in spring on their way to the north. Among these are the American Swallow and the Bank Swallow, the Snowy Owl, the Cedar Waxwing, the Sandpiper, the American Woodcock, the Black-crowned Night Heron, the great White Heron and the Green Heron, the Canada Goose, nine species of the Duck tribe, several species of Gulls, and the Thalassidroma Wilsonii or Mother Carry's Chicken. To these may be added, the Cohow, a bird of historic note in the early Chronicles of Bermuda, but now nearly extinct. A few pairs were seen some years ago, but no specimens are known to exist, and the vague descriptions of fishermen do not afford any clue by which to determine the species of this nocturnal bird.

Having said so much about the earth and the air, the sea now claims our attention as not less, if not more, prolific of life than the others. In the lower forms of life, on the line which bounds the animal and vegetable kingdoms, there are several striking examples to be found in these islands. In the class Porifera or Sponges there are several curious varieties. The most frequently met with as well as the largest, is S. fistularis. In the Polypi or lowest class of the Radiate sub-kingdom, there are innumerable examples and a great variety of species. In the Anthozoa division especially, the Hydroida, Helianthoida and Asteroida, are numerous and beautiful. These are the great Contractors by which the islands have been erected without cost or trouble to the proprietors. Night and day, with unwearied activity, many species of this class are converting the inorganic elements of the sea into "this too solid earth." The Pharoahs who built the Pyramids had not such a host as these at their command. Already they have achieved a victory over the turbulent sea, and if the world lasts as long again as it has done, they are destined largely to alter the face of nature on the seas. Their beautiful forms, their graceful movements, and their curious habits are a source of infinite delight to those who love to contemplate the wealth of

the Creator's wisdom and power. Of the class Echinodermata, there is also a large variety. We are not sure that any representatives of the ancient Encrinites have been seen in the Bermudas, but they are doubtless to be found. The Asteriadæ, or true Star fish and the Echinidæ, or sea eggs, are numerous, as well as striking in their forms, and beautiful in their colors. The Radiate Class Acalephæ or jelly fishes including the myriads of tiny Medusæ which fill the waters, are largely represented, among which may be noted the Physalia or Portuguese man-of-war. It is the delicate forms of these Medusæ that give the phosphorescent appearance to the ocean, and which makes sailing by night so like passing through a sea of fluid fire. In the sub-kingdom Articulata several families of crustaceans are very noticeable. The Cray-fish is found of a large size and is chiefly used as bait for fishing. Land and sea crabs are also numerous, of which not the least interesting are the soldier crabs. They may be seen carefully selecting empty univalve shells in which to take up their abode. They march about apparently with conscious pride, bearing these shells on their backs, and clothed in these cast off garments of a lower class of animals. In the Molusca division there is nothing very striking or peculiar in Bermuda. A large fine Pecten is much used as an article of food. Of the Vertebrata there are an infinite variety, and here as in other places this sub-kingdom is of great economical value. In spring the Greenland whale is a common visitant, and the capture of whales is a considerable business on the islands. With the whale comes the Selachii or the Sharks, and two species of Ray, the Mer-Ray and the Whip-Ray. Turtles are also found in summer. Fish is a common food of the inhabitants, and the poorer class of people seldom eat any other kind of animal food than fish. Of these they have an abundant choice. A large fish called the Grouper is caught in the summer at certain places on the coast, brought in alive, and stored in fish-ponds for future use. Another large and fine fish is called the Rock-fish ; another is the Hind, not so large as the former, but beautifully ornamented over its body with bright radiating spots. There are also the Angel-fish, the Hog-fish and the Grunter, with a variety of others which are caught at different seasons and in particular localities.

We now come to note the Marine Algæ, to the collection and classification of which our leisure time, during our residence there, was chiefly devoted. In this department of botany, the waters

of the Bermudas are very rich. The coral rocks with their caverns and sinuosities afford just the shelter and other requisite conditions required for the growth and propagation of Algæ. Accordingly we find a great abundance of individuals and a wide variety of species. The storms and the currents together drive them upon the shelving part of the shores, on which during the spring, summer, and autumn months, they may be gathered in great abundance, and in a good state of preservation. Besides this, the shallow bays and estuaries, and the deep pools formed in the hollows of the rocks, afford a rich harvest to the industrious collector.

This large and interesting Class of plants has been divided into three great Sub-Classes, distinguished exclusively by their color, and not by anything peculiar in their structure or habits. These colors are,—Olivaceous (Melanosperms); Red (Rhodosperms); Grass-green (Chlorosperms.) The last is characteristic of those Algæ which are found in fresh water, and in the shallow parts of the sea along the shores, and generally above half-tide level; this color is rarely found in plants that grow at any depth. The Olivaceous are almost entirely confined to marine species, and are found chiefly between half-tide and low-water mark, and those which inhabit deep water are of a darker hue and stronger texture than the others. The Red reach their maximum in deep water, and are seldom found above low-water mark, and those which are found between tides lose much of their brilliancy, and assume purple, orange or green tints. We have thus at the two extremities *green* and *red* colors, and between them the combination of both in the Olivaceous plants.

In the arrangement of these Sub-Classes, the Melanosperms being the most highly organized in their structure and fructification, and containing also the largest individuals of the family, are placed *first* in order. The Rhodosperms standing next in these particulars, and at the same time being the most beautiful in their structure and delicate in their tissues, are placed *second*. The Chlorosperms being the most simple in their structure and exhibiting in most cases a lower form of fructification, are placed in the *third* rank.

Our space will only permit us to give a catalogue of the Algæ we found in Bermuda under these three classes, and in doing so we adopt the classification of Harvey in his Nereis Boreali-Americana, so far as this monogram reaches. The Sub-Class Chlorospermæ has not yet been published.

I. MELANOSPERMEÆ OR FUCALES.

ORDER I. Fucaceæ. This order is the most extensive among the Melanosperms, comprising 230 species, more than half of which belong to the genus Sargassum; the rest are distributed into 20 or 30 generic groups. The largest number of generic forms are found between the parallells of 30° and 40°, N. and S. In the Northern seas this order is, however, more striking than in the southern, and covers a larger surface of coast. The American genera are seven in number, of which the following representatives are found in Bermuda, viz.: Sargassum vulgare, S. bacciferum) and several species not described by Harvey); Fucus, ceranoides and F. distichus.

ORDER II.—Sporochnaceæ. Sporochnus pedunculatus, a plant with a beautiful crested stalk consisting of bissoid jointed fibres.

ORDER IV.—Dictyotaceæ. Haliseris polypodioides; Padina pavonia and P. (undescribed). Zonaria parvula and Z. lobata; Taonia atomaria or Shroedaria; Dictyota dichotoma; D. crenulata; D. ciliata; D. intricata; D. Bartayresiana; Asperococcus sinuosus.

ORDER V.—Chordariaceæ. Mesogloia vermicularis; M. virescens; M. Griffithsia.

II. RHODOSPERMEÆ OR CERAMIALES,

ORDER I.—Rhodomelaceæ. Acanthophora Thierii; Digena simplex; Polysiphonia fibrillosa; P. elongata; Bostrychia scorpioides; Dasya Mucronata; D. pediculata.

ORDER II.—Laurenciaceæ. Laurencia obtusa; L. papillosa; L. scoparia, and several varieties.

ORDER III.—Corallinaceæ. Corallina officinalis; and several undescribed.

ORDER IV.—Sphærococcideæ. Botryoglossum platycarpum; Gracilaria multipartita; G. confervoides; G. armata; G. divaricata.

ORDER V.—Gelladiaceæ. Gelidium corneum; G. abnorme; Eucheuma isiformis or Wardemania; Hypnea musciformis.

ORDER VIII.—Helminthocladeæ. Helminthora divaricata; Liagora valida; L. pulverulenta.

ORDER IX.—Wrangeliaceæ. Wrangelia penicillata.

ORDER X.—Rhodymeniaceæ. Rhodymenia palmata; R. laciniata.

ORDER XI.—Cryptonemiaceæ. Gigartina Teedii; Chondrus crispus; Chylocladia rosea; Chrysymenia Halymenioidis; Ch. uvaria; Gloiosiphonia Capillaris.

Order XII.—Spyridiaceæ. Spiridia aculeata.

Order XIII.—Cerameaceæ. Ceramium rubrum; C. fastigiata, Calithamnion plumula; C. floccosum; C. luxurians.

III. CHLOROSPERMEÆ OR CONFERVALES.

Order I.—Siphoniaceæ. Codium Bursum; C. tomentosum; C. adhaerens; Bryopsis plumosa; B. hypnoidis.

Order II.—Confervaceæ. Cladophora pellucida; C. gracilis.

Order III.—Ulvaceæ. Enteromorpha ramulosa; Ulva latissima; U. Lactuca; U. Linza; U. (undescribed, laminate ribbon shaped, and with a sort of bifurcate termination, 6–12 inches long;) Porphyra laciniata (rare).

In this last division we have so far adopted the order given in Harvey's Manual of the British Marine Algæ, but there are several genera and species found in the Bermudas which are not described in that book, and these, too, are among the most beautiful and curious of the class, and are probably of the order Ulvaceæ; viz: Anadyomenia stellata; crisp to the touch; frond of a circular form, growing in small clusters; of a deep emerald green in the water, a gem of the sea, and of a beautiful stellate celular structure; Anadyomenia Anthrosaccia, a rare plant, consisting of a delicate cup-shaped green frond, with radiate tubular cells, set upon a calcareous stem one and a half inches long. This is the only marine plant that we know of, that assumes the appearance of a terrestrial flower. In its living state it is exceedingly beautiful.

There is also the beautiful genus Caulerpa or creeping root plants, which abound in deep pools, and on which the Turtles for the most part feed, viz., C. pilata, two varieties; C. prolifera; C. plumosa. Besides these, there are several confervoid plants in our collection which we have not been able to determine.

These are the ornaments with which the great ocean fringes the land which it embraces. These form the forests, the gardens and parterres in which the smaller fauna of the ocean delight to disport themselves and to hunt for their prey. The dark Olivaceous Fucales are many of them also iridescent and glisten in metallic lustre with the brilliant colours of the Rainbow. The Laurencia and the Dictyota form gardens in retired places of fine shrub-like fronds. The grass-green Uiva has more than the beauty of the richest velvet. The Bryopses with their delicate plumes, marginate the rocks at low tide. The clustered and branchy Eucheuma with its blood-red color, and other red

plants, add warmth to the general coloring. Thus it is that nature strives to cover with grace and beauty the otherwise nude and barren rocks of the sea.

Having said so much about the Natural History of these islands, it would be ungracious not to say something of their inhabitants. This is one of the Old World settlements. Here there were no Aborigines, excepting the insects, the crabs and the birds. The still vexed Bermoothes were supposed in Shakespeare's time to be inhabited only by "Gorgons and Hydras and Chimæras dire." Of inhabitants in these days, Bermuda generally has in its garrisons about 1000 soldiers, and in its hulks 1200 convicts; the civilians amount to about 12,000, two-thirds of whom are "colored people,"—the emancipated slaves and their descendants. The whites are for the most part a fine class of people, possessing the manners of English gentlemen; affectionate in their demeanor to strangers and hospitable to the full measure of their ability. If not remarkable for their piety they are at least religious. In morals they are not worse than like classes of people in England. Their education and intelligence are by no means behind the age. With the exception of a few lawyers, they are all engaged in commercial and agricultural pursuits, and are not devoid of enterprise or ability. The colored people here as everywhere exhibit the characteristic features of the race. Emancipated from the slavery and the tutelage of their owners, without the previous preparation of education, they have not always shown that sagacity and wisdom in the use of their liberty, and in the improvement of their condition which might be desired. The antipathy between the races is besides very strong here. Neither in churches, schools, nor in social life, do they associate together. It is however wrong, as a recent American writer asserts, to say, that emancipation is here a failure. It cannot be denied, even by the most prejudiced, that the colored people are now in a greatly better social, moral, and religious condition than they were in 1834. It is alleged that they are lazy and wont work. Some of them certainly are so; but so are some whites. If the black man does not work, neither does the white. Besides, he wont work for nothing or without a motive any more than the white. It is to us wonderful that considering the immoral influences to which the blacks were and are exposed, that they are not worse than they are. Nevertheless, we say, that they are upon the whole an industrious people. They do almost all the work that is done on the island. They

build ships and boats. They are famous fishermen, daring boatmen, and skilful pilots. They do all the loading and unloading of ships. They cultivate almost all the land, and raise ninety-nine hundredths of the potatoes, onions, tomatoes, and arrow-root, which constitute the commercial wealth of Bermuda, and these are no inconsiderable items. They have been all but excluded from any influence in the government. The Legislature were so frightened in 1834 that they raised the property franchise to an amount beyond the reach of any excepting a few of the most fortunate of the colored race. That they are somewhat ignorant we grant; but what schools have been provided for them? A few miserable things. We shall ever stand up for the blacks. Our opinion is, that had they the government of the island in their hands for five years, they would not manage legislation worse than the whites, but would unquestionably put some life into the old stagnant system of Colonial polity.

The government of the Islands is the old irresponsible form of administration, which, till within a few years, prevailed in all the British Colonial possession. There is a Governor appointed by the Crown, and a Council or Upper Chamber, whose members, eleven in number, hold office for life, and are nominated by the Colonial Office. The Parliament proper, or House of Assembly, consists of four representatives from each of the nine tribes or parishes, into which the country is divided. These members of the Legislature must be residents, and must hold property in the parishes which they represent. For the Franchise there is also required a property qualification of considerable amount for Bermuda. The judiciary is formed upon the English model, and consists of a Court of Chancery, a Court of Errors, and a Court of General Assize.

Taking the Natural History of the Bermudas as a whole, from man, the crown and top of the Vertebrata, to the tiniest of the Porifera—from the "Cedar to the Hyssop," in the domain of Flora—and from the greatest to the least striking aspects of the inorganic land and sea, we find much to love and to admire, and reasons innumerable for unbounded praise to the God who made them all.

Miscellanies.

Introduction to Cryptogamic Botany, by the Rev. M. J. Berkeley, M. A., F. L. S. With 127 *Illustrations on Wood, drawn by the Author.* Lordon and New York: H. Bailliere. Price, $5. 1 vol. 8vo, pp. 604. Being Volume XII of Bailliere's Library of Standard Scientific Works.

An introductory work on the Cryptogams in the English language and at an available price, has long been wanted. Hitherto the student of these lower forms of vegetation could find no treatise to assist him excepting Dr. Lindley's *Vegetable Kingdom*, and more lately "The Micographic Dictionary," neither of which were special treatises, nor calculated to fill his necessities. No one was more competent to supply the want than the author of the work before us, who has devoted a good part of his life to the study of these organisms, and has in them earned a world-wide reputation among botanists. That the nature of the work may be the better understood, we extract the following from the preface, and give a summary of its contents:

"It remains only to state that the work is not intended nor calculated for persons who have not already some general knowledge of Botany. At the same time, it is believed, unless the Author has entirely failed in his attempt, that there is no part which is not intelligible to any one who has made himself master of Dr. Lindley's or Dr. Balfour's Introductions to the Study of Botany."

A concise and able introduction occupies the first 70 pages; we have only room for the following extract from it, to which we invite the attention of our microscopic readers:

"I shall not dwell upon the extreme and manifold interest of the several objects which come within the view of the Cryptogamist. If variety and delicacy of structure, beauty of form and colour, and the nicest transitions from group to group, from genus to genus, besides a host of curious questions of physiology and adaptation of means to particular ends, are worthy to engage attention, Cryptogams most surely will not be amongst the most

unprofitable objects of study. There will be scope, too, for the acutest powers of thought and observation, unless he is content merely to skim the surface of things. Even independently of the necessity of using optical instruments, a point very much exaggerated, for if the minuter points of physiology in Phenogams are deeply studied, no less an amplifying power is necessary, and perhaps even greater tact and skill in manipulation, the difficulties which arise from the wide limits within which not merely species but accredited genera are capable of varying, are sufficient to exercise the highest mental qualifications. It does not follow, however, that the end obtained should be at all proportional to the necessary labour. The objects which the accomplished Cryptogamist has in view are not comprised within the mere determination of species, or the admiration of the exquisite forms and combination which meet him at every turn. If he aims at nothing higher than the first, he may indeed be useful in his generation, provided he be cautious enough, and possessed of sufficient self-denial to prevent his striving to glorify himself, rather than to clear the road for investigators of higher pretensions. If beauty of form and singularity of structure be alone his object, his time may be passed agreeably enough; but in most cases, like ten thousand microscopists of the present day, he will be but a mere trifler, without any better aim than innocent amusement; or, if he be a dabbler in science, with some wish to attain reputation which he has not the patience to seek after by a continued course of study and mental discipline, he will be deriving general inferences from isolated, half-understood facts to the detriment and confusion of real science. Perhaps of all literary dissipation, the desultory observations of the mere microscopist are the most delusive. And even where the objects are higher, it is well that every one whose attention is much directed to this greatly abused instrument, should remember that if he wishes to penetrate the secrets of nature, he must look beyond his microscopist,—a fact of which some microscopists of considerable reputation do not seem at all aware. The paramount importance of the subject is to be seen in far different matters."

The author divides Cryptogamic plants into two great classes, THALLOGENS AND ACROGENS, described and sub-divided as follows:

Class I.—Thallogens.—Seldom herbaceous or provided with foliaceous appendages, * * * * Spermatozoids not spiral.—Comprises

ALLIANCE I. Algales, (*Sea-weeds.*)—Deriving nutriment from the water in which they are submerged.—Occupying 150 pages.

ALLIANCE II. Mycetales.—Deriving nutriment from the matrix or the surrounding air; mycelium more or less evident.—Subdivided into

1. Fungales (*Fungi*). Occupying 137 pages.
2. Lichenales (*Lichens*). Occupying 57 pages.

Class II.—Acrogens.—Mostly herbaceous, and provided with foliaceous appendages. * * * * Spermatozoids spiral.—Comprises

ALLIANCE III. Characeales (*Charas*)—Spores solitary.—A small order containing but three genera. Occupying 5 pages.

ALLIANCE IV. Muscales (*Liverworts and Mosses*).—Spores numerous, giving rise to a plant which produces one or more successive of fructifying archegonia.—Occupying 70 pages.

ALLIANCE V. Filicales (*Ferns and Allied Plants*).—Spores numerous, producing a prothallus which bears a single set of archegonia, which yield fructifying plants.) Occupying 57 pages.

The absence of a synoptical table of contents, and of a running title to the right-hand page, is in some measure compensated for by the unusually full index at the end of the volume, where the reader will also find a valuable classified catalogue of the most note-worthy works relating to Cryptogamic Botany.

The Publisher has done his part to make the book valuable; the printing being good, the type clear, and the engravings though scant in numbers sparse—well executed. The paper of our copy is, however, uneven; the first half of the volume being of much better quality than the remainder.

A Scientific Exploring Expedition, consisting of three or four persons, is about to proceed, under the sanction of the government, through the Western portion of British America. It is intended that the party should proceed from Lake Superior to Lake Winnipeg, and from thence through the country lying between the northern branch of the Saskatcharan and the boundary of the United States. The government is desirous of making the Expedition as scientifically useful as possible; and with this view, the assistence and counsel of the Royal Society have been solicited. The Council has appointed a Committee to act in the matter, and a report has been drawn up. The Expedition is to be commanded by Mr. John Palliser.—*Athenæum*, April 25.

Memoir of John Dalton, and history of the Atomic Theory up to his time; by Robt. Angus Smith, Ph. D.F.C.S. (Published also as vol. xiii, New series, of the Memoirs of the Literary and Philosophical Society of Manchester.) 298 pp. 8vo. London, 1856, H. Baillière.—In the life of a philosopher or the history of a principle in philosophy, when either is faithfully executed, there is profound instruction. They not only teach us methods of research, but illustrate its true spirit and aim, and the secret of its strength. The young student will search the world over, unsuccessfully perhaps, for a subject for investigation. The philosopher finds a subject in the most familiar phenomena about him, and by steady scrutinizing labor, draws forth facts and principles of fundamental value. The history of Dalton and his atomic theory has for this reason as well as others a special value to the student in science. The work of Dr. Smith has a peculiar merit, from its bringing out Dalton's theory of atoms in its true relations to the speculations of former centuries. He treats briefly of the views on atoms among the ancient Greeks, and thence traces the subject through the period of Alchemy and the earliest beginning of Chemistry to the development of Dalton himself when the mathematical basis of this science and its simple system of numbers were first made clear. A fine portrait of Dalton forms a frontispiece to the volume.—"*Silliman's Journal.*"

Electric Illumination.—A few weeks since, some experiments on electric illumination were made at Paris, surpassing all that had before been done. The success was due to an electric regulator invented by MM. Lacassagne and Thiers, called by them an *electro-metric* repeator. It is complicated in structure and cannot well be described here. The inventors placed four of their electric lamps on the platform of the Arc de Triomphe de l'Etoile, and projected the light one day on the Champs Elysées, towards the Place de la Concorde, and a second on the avenues of Neuilly or de l'Impératrice, the change having been made because of the numerous gas lights of the Champs Elysées. These gas lights were made to look dull and smoky, yet diminished the effect of the electric light; but in the aveuues of l'Impératrice the light presented intense brilliancy.

Each lamp was sustained by means of sixty of Bunsen's pairs, and furnished with a spherical reflector of metal, or of glass silvered by a battery in the manner described beyond.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF JUNE, 1857.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	....	....	6 a. m.	2 p. m.	10 p. m.
1	29·522	29·344	29·139	51·1	80·1	60·0	·361	·648	·499	·93	·64	·95	N. E. by E.	S. by E.	S. S. W.	0·40	0·43	8·27	0·200	....	Clear.	C. C. Str. 6.	C. Str. 8.
2	454	254	433	60·1	75·5	58·0	·467	·607	·351	·89	·71	·73	S. W. by S.	S. S. E.	W. S. W.	0·01	2·16	12·30	....	....	Cirr. Str. 3.	" 4.	Clear.
3	352	314	359	57 0	66·0	58·6	·345	·416	·345	·72	·65	·84	W. S. W.	W. S. W.	S. W.	12·10	10·50	4·02	Inapp.	....	" 2.	C. Str. 6.	C. Str. 4.
4	414	502	626	51·0	57·0	41·5	·293	·355	·234	·77	·74	·74	W.	W. N. W.	W. by S.	0·53	16·57	9·00	....	....	Clear.	" 8.	Clear F. Aurora Bore
5	661	612	560	40·5	62·3	46·6	·227	·397	·226	·85	·71	·70	N. W. by W.	W. by S.	W. b.	2·08	12·22	10·11	....	....	"	" 6.	C. Str. 4.
6	528	514	437	52·2	62·3	46·2	·304	·397	·251	·76	·72	·89	W. S. W.	W. by S.	W.	1·32	5·60	8·90	0·355	....	"	" 4.	Rain.
7	469	420	535	50·0	72·1	54·1	·304	·473	·326	·81	·61	·76	W.	W. S. W.	S. by W.	·91	0·48	0·21	0·266	....	"	" 4.	Clear.
8	650	714	796	57·0	75·1	67·5	·376	·498	·366	·79	·58	·55	W. S. W.	S.	S.	0	0·00	0·00	....	....	"	Clear.	C. Str. 2.
9	712	764	793	55·7	78·5	62·0	·351	·498	·421	·79	·52	·75	E.	S. S. E.	S. S. E.	0·00	7·56	5·40	....	....	C. Str. 4.	C. C. Str. 4.	" 6.
10	656	546	515	64·1	85·5	66·5	·504	·692	·544	·84	·58	·85	S. by W.	S.	S.	0·10	0·45	0·20	1·733	....	C. C. Str. 6.	Cirr. 2.	Str. 2.
11	318	211	28·937	60·0	62·0	58·0	·494	·528	·472	·94	·94	·96	S. S. E.	E. S. E.	S. S. E.	0·22	0·75	3·73	0·587	....	Rain.	Rain.	Rain.
12	29·017	168	29·259	57·5	66·1	58·5	·447	·464	·437	·94	·72	·89	W. N. W.	W. N. W.	S. W. by W.	5·85	18·76	8·12	0·221	....	Rain.	C. C. Str. 6.	Str. 8.
13	317	395	399	54·3	73·4	52·5	·349	·541	·373	·81	·67	·93	S. S. E.	W. by S.	N. W.	1·98	5·10	6·03	....	....	C. Str. 10.	C. Str. 1.	Clear, Thunder.
14	520	639	751	57·0	62·5	50·1	·515	·421	·304	·82	·75	·81	W. N. W.	N. W.	N. by W.	15·22	19·77	11·17	....	....	Str. 4.	" 6.	"
15	793	734	745	48·7	67·7	54·2	·281	·431	·349	·80	·65	·81	N. W. by W.	W. by S.	N. E. by E.	2·80	3·01	7·70	....	....	Clear.	Clear.	"
16	813	713	720	51·0	65·1	53·6	·293	·425	·361	·76	·68	·87	N. E. by E.	W. by S.	W.	1·67	0·27	0·33	....	....	Str. 2.	C. C. Str. 8.	Str. 4.
17	692	705	707	51·0	58·1	53·0	·337	·462	·386	·87	·94	·93	E. by W.	S. S. E.	S. E.	0·13	12·12	0·30	0·478	....	C. Str. 10.	Rain.	C, Str. 8.
18	650	629	625	53.5	59·7	55·5	·394	·452	·432	·96	·89	·94	E. S. E.	E. S. E.	E. S. E.	5·47	7·05	3·55	0·389	....	Rain.	Rain.	C. Str. 10.
19	565	540	634	57·3	72·1	60·9	·449	·638	·511	·94	·82	·94	S. S. E.	S. by W.	S. S. W.	2·77	3·23	8·47	Inapp.	....	C. Str. 4.	C. Str. 10.	" 8.
20	656	669	221	65·0	78·1	65·7	·560	·578	·555	·90	·61	·85	W. by N.	W. S. W.	E. N. E.	1·13	1·02	1·05	0·136	....	" 10.	Cum. 1.	" 9.
21	563	818	656	62 0	72·3	61·4	·445	·555	·450	·79	·71	·84	W. by S.	W. by S.	S. W.	10·22	6·72	3·41	0·186	....	Cum. 4.	C. C. Str. 2.	Clear Aurora Borealis.
22	565	514	444	56·9	72·5	59·0	·449	·550	·479	·96	·71	·95	E. by S.	E. by S.	N. E. by N.	0·01	4·01	3·03	0·183	....	C. Str. 10.	"	Rain.
23	·425	597	663	56·5	63·1	55·6	·432	·461	·371	·94	·79	·84	N. N. W.	N. W. by W.	N. W. by W.	15·75	19·00	15·70	1·230	....	Rain.	C. Str. 8.	C. Str. 10.
24	625	714	729	50 0	71·6	63·1	·314	·532	·461	·83	·70	·79	N. W. by W.	N. W. by W.	W. by N.	14·96	8·36	17·32	....	....	Clear.	Clear.	Clear.
25	624	622	627	60·0	71·7	64·5	·416	·588	·504	·79	·98	·84	S. W. by S.	N. by S.	N. W.	8·10	1·96	24·07	Inapp.	....	C. C. Str. 6.	Cirr. Str. 6.	Cirr. 4. Dist. Thunder.
26	612	615	701	62·0	74·8	31·5	·445	·532	·362	·79	·64	·66	N. N. W.	N. W.	N. W. by W.	0·30	8·80	9·98	....	....	Clear.	Clear.	Str. 4.
27	695	680	812	57·0	83·3	65·0	·376	·681	·527	·79	·61	·85	N. W.	S. W.	S.	0·87	8·72	1·52	....	....	"	"	Clear.
28	831	787	779	60·6	83·4	61·6	·416	·617	·466	·79	·56	·79	E. S. E.	S. E. by E.	S. E.	2·13	3·26	0·46	....	....	"	"	"
29	655	608	640	60·1	78 9	61·0	·381	·578	·476	·73	·61	·79	E.	E.	E. N. E.	4·85	8·81	8·17	....	....	"	Str. 4.	C. Str. 4.
30	709	646	567	63·0	64·0	57·5	·435	·476	·447	·75	·79	·93	S. S. E.	S. S. E.	S. E. by E.	5·47	7·43	1·21	0·130	....	C. Str. 8.	C. Str. 10.	" 10.

REPORT FOR THE MONTH OF JULY, 1857.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	....	....	6 a. m.	2 p. m.	10 p. m.
1	29·670	29·712	29 846	77·3	70·0	58·0	·447	·623	·462	·94	·86	·94	S. E. by S.	S. S. E.	S. S. E.	2·86	1·40	2·68	0·036	....	C. Str. 10.	C. Str. 4.	C. Str. 8.
2	29·941	30·000	29·948	63·0	80 0	60·0	·461	·681	·467	·79	·68	·88	S. S. E.	S. by E.	S.	0·27	2·00	0·23	....	....	" 2.	Clear.	" 2.
3	909	29·814	728	59·0	80·0	60·8	·426	·588	·456	·84	·58	·84	N. W. S. W.	S. by W.	S. by W.	0·10	2·97	1·71	....	....	Clear.	C. Str. 2.	" 2.
4	726	712	862	60·5	78·9	52·0	·441	·492	·304	·84	·52	·76	W. N. W.	N. N. W.	N. W.	1·76	6·26	6·33	....	....	Cirr. 2.	Clear.	Clear.
5	912	885	994	44·6	80·5	61·5	·241	·588	·456	·79	·58	·84	S. S. E.	W.	S. W.	0·07	0·06	0·07	....	....	Clear.	"	"
6	883	872	755	50·8	85·1	66·5	·349	·628	·544	·93	·53	·85	S. W.	W. by S.	S. W. by S.	0·01	0·22	0·67	....	....	C. C. Str. 4.	C. Str. 2.	"
7	638	615	667	65·8	74·1	62·9	·499	·681	·445	·80	·82	·79	W. S. W.	S. W. by W.	N. by E.	3·13	12·20	8·91	Inapp.	....	Light Cirr.	" 10.	"
	862	794	738	55·5	81·7	62·0	·331	·638	·397	·74	·61	·71	N. W. by W.	N. W. by N.	S. W. by W.	7·73	1·83	8·40	....	....	Clear.	Clear.	"
9	956	934	968	60·9	84·5	64·4	·371	·638	·504	·71	·56	·84	S. W.	S. W.	S W.	0·20	0·15	1·80	....	....	"	C. C. Str. 4.	Str. 4.
	853	905	967	60·0	85·5	68·5	·494	·632	·613	·90	·58	·85	S. by E.	S. W.	S. S. E.	0·22	2·83	0·01	....	....	C. Str. 6.	Cum. Str. 8.	Cirr. 1.
	29·898	885	802	64·9	93·4	73·6	·527	·854	·628	·85	·53	·78	W. S. W.	W. S. W.	S. W. by S.	0·23	0·85	4·43	....	....	Clear.	Clear.	Clear Ft. Aurora Borealis.
12	805	744	777	94·1	90·0	72·4	·648	·776	·670	·78	·56	·85	S. W. by W.	W.	E.	0·63	0·77	1·23	....	....	"	C. Str. 9.	C. C. Str. 4. Dist. Thun.
13	772	725	730	77·6	88·6	76·0	·681	·925	·727	·74	·71	·82	S. S. W.	S. S. W.	S. by W.	0·12	1·38	0·41	....	....	Fog.	C. C. Str. 8. Dist. Thun.	Clear.
14	828	772	697	74·0	97·6	73·4	·681	·986	·692	·82	·51	·86	S. S. W.	S. by W.	S. by W.	0·10	2·43	0·32	....	....	Clear.	C. Str. 4.	"
15	714	666	702	77·1	94·3	73·5	·648	1·136	·692	·71	·68	·86	S. W.	S. by E.	S. W. by W.	0·12	3·13	4·10	....	....	"	" 4.	C. Str. 4. Light in N. E.
16	711	709	740	75·1	90·0	67·8	·670	·896	·646	·78	·65	·94	S. by W.	S. by W.	S.	0·08	0·89	3·10	0·180	....	"	C. C. Str. Thunder.	" 10.
17	711	704	725	69.5	86·0	71·6	·668	·955	·715	·94	·78	·94	S. E. by E.	W. S. W.	N. E. by W.	0·83	0·83	7·83	0·499	....	Rain.	C. Str. 10.	" 9.
18	666	570	607	66·4	92·3	73·6	·605	·896	·727	·94	·59	·90	S.	W. by S.	S. S. W.	0·80	0·13	1·80	....	....	C. Str. 9.	C. C. St. 4.	Clear.
19	526	518	471	73·0	70·3	70·4	·692	·715	·715	·86	·94	·93	S. W.	N. by W.	S.	1·10	3·05	4·40	1·036	....	" Thunder.	Rain.	Str. 3.
20	438	431	492	74·2	79·0	68·8	·715	·763	·646	·86	·78	·91	S. W. by W.	S. W. by W.	S. by W.	6·68	1·03	0·10	....	....	" 10.	C. Str. 10.	C. C. Str. 4.
21	29·476	514	475	66·1	73·0	67·0	·571	·327	·626	·89	·90	·94	N. E. by E.	E. S. E.	E. N. E.	0·52	4·12	1·06	0·899	....	" 10.	" 9.	" 4. Thunder.
22	556	640	782	68·0	71·8	58·0	·650	·588	·712	·96	·78	·84	E. N. E.	E. N. E.	E. N. E.	7·16	12·92	15·49	....	....	" 10.	" 4.	" 9.
23	820	826	814	57·0	86·4	59·0	·376	·698	·778	·79	·53	·95	N. E. by E.	N. E. by E.	E. by N.	29·56	13·70	12·56	1·105	....	" 10.	C. C. Str. 8.	Cirr. Str. 10.
24	786	787	747	60·7	65·5	63·0	·411	·578	·546	·84	·96	·94	E. by N.	N. W. by W.	S. E, by E.	5·47	2·07	1·48	0·991	....	Cirr. Str. 4.	Rain.	Str. 4.
25	812	793	849	62·2	81·0	68·0	·528	·739	·613	·94	·71	·89	S.	W. S. W.	S. W.	1·17	5·92	2·12	0·170	....	C. Str. 9.	C. Str. 4.	Str. 4. Thunder.
26	882	787	864	69·5	89·0	70·6	·634	·868	·628	·90	·65	·86	S. W. by W.	W. S. W.	S. W. by S.	5·25	7·17	2·22	....	....	Str. 2.	" 4.	Clear.
27	843	754	704	68·6	92·0	72·7	·613	·670	·704	·89	·44	·90	S. W. by S.	S. W.	S. S. W.	0·55	2·36	0·28	....	....	Clear.	" 2.	C. Str. 4.
28	557	612	726	75·5	79·7	66·7	·739	·628	·574	·86	·64	·89	S. W. by S.	S. W. by S.	S. W. by S.	3·45	6·40	12·73	Inapp.	....	C. Str. 6.	" 4.	C. C. Str. 4.
29	754	799	963	59·3	74·1	64·8	·478	·617	·534	·93	·74	·89	N. N. W.	N. W.	S. W.	5·92	3·25	0·01	....	....	Clear.	" 2.	Clear.
30	947	836	855	62·0	83·0	61·0	·528	·617	·534	·93	·56	·89	S. E.	S. S. E.	S.	1·14	4·22	3·07	....	....	"	C. C. Str. 4.	Cirr. Str. 4.
31	734	614	548	63·0	79·9	63·6	·516	·715	·546	·89	·71	·94	S. S. E.	S. by E.	S. by E.	6·12	0·47	9·31	0·902	....	C. C. Str. 8.	C. Str. 6.	Cirr. Str. 10.

REMARKS FOR JUNE, 1857.

Barometer.
- Highest, the 21st day, 29·818 inches.
- Lowest, the 11th day, 28·937 "
- Monthly Mean, 29·615 inches.
- Monthly Range, 0·881. "

Thermometer.
- Highest, the 10th day, 85°9
- Lowest, the 6th day, 39°2
- Monthly Mean, 61°44.
- Monthly Range, 46°7.

Greatest intensity of the Sun's rays, 121°9.
Lowest point of Terrestrial radiation, 36°1.
Mean of Humidity, 786.

Amount of Evaporation, 3·430 inches.
Rain fell on 16 days, amounting to 6·212 inches; it was raining 61 hours and 58 minutes, and was accompanied by Thunder on 2 days.
The most prevalent wind was the W. by S. The least prevalent wind was the E.
The most windy day was the 23rd day; mean miles per hour, 16·81.
Least windy day, the 8th day; miles per hour, 0·00.
Aurora Borealis visible on the 2nd night.
The Electrical state of the Atmosphere has indicated moderate intensity.
Ozone was in moderate quantity.

REMARKS FOR JULY, 1857.

Barometer.
- Highest, the 2nd day, 30·000 inches.
- Lowest, the 20th day, 29·431 "
- Monthly Mean, 29·751 inches.
- Monthly Range, 0·569 "

Thermometer.
- Highest, the 14th day, 98°7.
- Lowest, the 8th day, —46°8.
- Monthly Mean, 71°57.
- Monthly Range, 41°9.

Greatest intensity of the Sun's rays, 122°0.
Lowest point of Terrestrial radiation, —44°6.
Mean of Humidity, ·800.

Amount of Evaporation. 2·85 inches.
Rain fell on 11 days amounting to 65·735 inches: it was raining 29 hours 57 minutes and was accompanied by Thunder on 7 days.
Most prevalent wind the S. W. Least prevalent wind the E.
Most windy day, the 23rd day; mean miles per hour, 15·60.
Least windy day, the 5th day; mean miles per hour, 0·06.
Aurora Borealis was visible on 1 night.
The Electrical state of the atmosphere has indicated constant and high tension.
Ozone was in rather small quantity.

and furnished with a spherical reflector of metal, or of glass silvered by a battery in the manner described beyond.

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ARTICLE XX.—*Notes on Insects now injuring the Crops in the vicinity of Montreal*, by WILLIAM STEWART M. D'URBAN, Sub-curator, Montreal Natural History Society.

My object in communicating the present paper, is to call the attention of this Society to the ravages which certain insects are at this moment committing amongst the crops in our vicinity, and to give such information about them as I have been able to collect. I trust some one with more leisure than myself will be induced to turn his attention to this interesting subject, and endeavour to complete the history of the different species of which at present we are quite ignorant.

Being anxious to investigate the insects injurious to Agriculture in this country, I begged James Logan, Esq., to inform me when any species were observed infesting the crops on his property near Montreal. Accordingly about the middle of this month he kindly told me that "Cutworms" and other insects had been committing great havoc amongst his oats and Indian corn, &c.,

this spring, and on the 15th inst., I walked out with him to his farm; we first examined a patch of *Indian corn*, or maize, about $1\frac{1}{4}$ arpents in extent; it was planted from 23rd to 28th May. The soil of the field is a sandy loam, and was ploughed from grass last autumn; the plants were two or three inches high, but so many had been killed, it had been sown over a second time on the 8th June, and this last sowing had hardly sprouted at all. As soon as we reached the field we perceived many plants looking dead and withered, and set deeper in the soil than the healthy ones; on laying hold of these they instantly came up in our hands, and we found them cut through about half an inch below the surface of the ground; many had been severed at the junction of the stalk and the grain, and thus entirely destroyed; some had their tops cut off above ground, and the leaves eaten: these will probably shoot again; many stalks were only partially cut through, but as the "worms" appear to eat out the heart of the plants, they are as effectually destroyed as if eaten entirely through. In most instances every plant in a clump or "hill" had been killed, though sometimes one or two of the strongest had been left untouched; in a portion, about twelve paces long, of one row, every plant on every hill was destroyed. On removing the earth from around the withered plants, we discovered a red-headed greyish larva coiled up just below the surface of the ground; we found one or two in almost every hill which we examined, and which showed any signs of their presence; but in a few cases we did not see any, probably having accidentally covered them up with the soil, or perhaps they had shifted their quarters during the night; I did not find more than two or three in the same clump. In about an hour we dug up between 60 and 70 larvæ from two or three rows of corn, they varied in size from 5 lines long and 1 line thick to 17 lines long and 3 lines broad, but were generally about 8 lines long. The pumpkins sown amongst the Indian corn had not been touched by them. Besides the "Cutworms" I found two or three "Wireworms," the larvæ of a coleopterous insect of the genus *Elater*, which were eating the seeds and stalks of the young corn under ground. We next inspected a patch of oats, 8 arpents in extent, in the same field, separated, however, from the Indian corn by a deep but grassy ditch; it had also just been resown; at a distance, large irregular patches of the field appeared quite bare, and on looking at them closer we perceived that in these spots almost every plant had been killed, and we found at

their roots a good many of the same larvæ as those destroying the maize; they were not however so numerous as in the latter. They were first noticed among the oats about the 25th May, when the Indian corn was not up, I am therefore inclined to think they deserted the oats for the corn as soon as it came up; the infected plants presented the same appearance as those of the corn, except that they were whiter and more sickly looking, most having quite dried up. At the side of the field where a dung heap had stood, the oats were very luxuriant, and at a little distance did not appear attacked by the "worm," but on closer examination we found many at work at these also, and of rather a larger size than elsewhere; I found one or two dipterous larvæ at the roots of the oats but whether eating them or not I could not determine. I noticed *Calosoma calidum* running across the field, and I have no doubt this fine beetle, both in its perfect and larval states, is extremely beneficial in destroying the Cutworms, and also the larvæ of that pest, the common Apple Moth, (*Clisiocampa Americana*). It may sometimes be seen running up trees in search of the latter. A specimen I enclosed in a small box with some Cutworms soon demolished them. It is much to be regretted that a prejudice exists against this useful insect, and that many persons make it a practice to crush all they see; and as this species is constantly running about in the daytime, great numbers must be destroyed in this manner; I frequently see them lying crushed on the pathways round Montreal, and I never pass one of these unfortunate victims to popular delusion without feeling a pang of regret that it should have met with such an unscientific fate. But by far the greatest enemy of the "Cutworm" is a long black larva, somewhat flat and linear in shape, and most probably also Carabidous, which I found rather numerous amongst the oats, concealing itself under the lumps of earth, and rapidly burying itself if disturbed; the largest was about one inch and 3 lines long, but most were only 7 lines in length; I found one which had just been engaged in sucking out the juices of an unlucky Cutworm, of which it had left nothing but the shriveled skin; a single specimen confined with several Cutworms and a larva of Clisiocampa, destroyed them all in the night, and became enormously distended, having swollen to about twice its natural size, which however it regained by the next day. I find by experience that one of these larvæ takes about an hour and a half to finish a single Cutworm, passing it gradually between its jaws till all its

juices are squeezed out. If one be kept without food for some time, and a Cutworm be dropped into the box, it is amusing to witness the fury with which it is seized as soon as perceived; the moment the worm is laid off, it throws itself about with such violent contortions that its antagonist is thrown from side to side, but this avails it not, for it cannot loosen the hold of those merciless jaws; if however the Carabidous larva should happen to seize its prey by one of its anal segments, the worm turns round and inflicts such a bite as instantly compels it to retreat, but the hard plates with which the anterior part of its body is clothed, and which are doubtless intended as a defence against this very danger, protect it from being much injured, and it soon returns to the charge, and takes good care to fasten itself the second time close behind the head of the Cutworm, which effectually puts an end to the latter's powers of resistance. I left two together in a box over night, and when I next looked at them one had appeased its hunger on the body of its companion, leaving nothing but its dry skin. The Cutworms, if confined together without much food, have the same cannibal propensity, soon destroying each other; nor is it always the strongest which devours the weakest, for I found two small specimens had destroyed a large one with which I put them. When one seizes another, it never lets go its hold till it has sucked out all the nutriment its victim contains.

The following is a description which I have drawn up of the *Cutworm of the Indian corn and oats.*—No. 1. Smooth and semitransparent; head, red; corneous shield on the first segment next the head, dark brown; all the rest of the segments greyish white, (almost pure white immediately after changing its skin, and dark grey when full of food) with numerous small polished spots of a darker shade than the ground colour, and arranged by pairs down the back and sides; it has also a few very fine scattered hairs, mostly proceeding from the small spots.

Dr. Asa Fitch, in his admirable reports on the noxious insects, of the State of New York, page 312, describes five species of Cutworm, and the present appears to agree with the description of that termed by him the "Red-headed Cutworm;" I found one of the same species at the roots of grass in one of Mr. Logan's fields, and it may be commonly found under stones, in the early spring, as soon as the snow clears off the ground, but it is then only of small size.

When Mr. Logan and myself had concluded our examination of his oats, we proceeded into the adjoining field, containing mangold wurzel, and only separated from the last by a wooden fence: it was sown on 30th April and 1st May; I observed that the hearts of many of the young plants had been eaten out and the leaves consumed, and some were cut below the surface of the soil. Having little time to spare, I only found one large lepidopterious larva, of a different species from that amongst the oats; and more resembling the larva of a *Graphiphora* than that of an *Agrotis*. The following is a description of it:—

Cutworm of the Mangold Wurzel, No. 2.--Length, 16 lines; smooth, dark brownish-grey, but not transparent; head and *corneous* shield of 1st segment, black striped with white; faintly lined down the back and sides, and covered with numerous polished dots similar to those in number 1, but darker and differently arranged; 3 black dots on each segment over each spiracle, which is also black. This larva has since died; it does not answer to any of those described by Dr. Fitch.

Oats were grown in this field last year, and they then suffered much from the "Red-headed Cutworm," it was ploughed from grass the previous year, mostly in Autumn, but a part now under beans not till the spring before last; and the oats which grew on it were much more injured by the Cutworms than the rest, probably from the larva in the grass having been undisturbed all the winter. I noticed that the little brown *Turnip Beetle* (Haltica) was already very numerous, and had eaten small round holes in the leaves of the young mangold wurzel. The horse beans in this field were looking remarkably well, and I understand they have not been injured by anything; they were sown on 23rd and 24th April. On the 24th inst., I again walked out to the farm, the second sowing of Indian corn had been up a day or two, and the persevering Cutworms had commenced on this also; I found a good many, and some were still small, being only about 7 lines long, but they were by no means as numerous as the first day, probably owing to their having been disturbed by farming operations; for Mr. Logan, despairing of his crop of maize, had sown Turnips with a sowing machine along the rows of corn; and had also applied a dressing of guano to the surface during rain. The Halticas had already found them out, although only a quarter of an inch above ground, and were busily engaged planning their

destruction; I found one specimen of a small green lepidopterous larva at the roots of a plant of corn.

Lepidopterous Larva of the Indian Corn, No. 3.—Length 7 lines, pale green with longitudinal stripes of white and a darker shade of green. I am not aware to what genus this belongs. The Chipping Sparrow (*Embriza socialis*) was numerous in the field, amongst the corn and oats, and I saw one with what I thought a Cutworm in its bill. I have little doubt these birds, as well as crows, &c., are very useful in thinning the numbers of this destructive insect. The oats had grown a good deal, some guano and salt had been thrown over the second sowing of them; the worms were not numerous, but I found several large sized specimens at the roots of the rank plants growing where the dung heap had been.

The Mangold Wurzel had been thinned out, I am told some larvæ were found in it, but as I did not see them, I do not know of what species they were.

Having now given in detail the hasty observations which I was able to make in two short visits to the infested fields, I will add some illustrations of the Natural History of the family of Moths which produce the Cutworms; want of time prevents my again noticing the Coleopterous and Dipterous larva previously mentioned.

The "Cutworms," as they are termed in America from their peculiar mode of destroying plants by gnawing through them with their powerful jaws, and some of which I now exhibit, are the larvæ of Lepidopterous insects of the family Noctuidæ, and principally of the genus Agrotis, a widely distributed group of Moths. All the numerous species of this genus are, in the larva state, nocturnal and underground feeders, eating the roots and leaves of various low plants, and are all more or less destructive to the Graminaceæ, being great enemies to the farmer from their partiality to the various cereals. All the species in their perfect form fly by night, concealing themselves during the day in dark places, such as crevices of walls, behind bark of trees, in long grass, &c., but some may be found asleep in the day time, on the flowers of the golden rod, and similar plants, in the autumn. Exclusive of doubtful natives, not less than 23 species inhabit Great Britain. In America the number of species is also large; some of the species are cosmopolitan, and several found in this country also occur in England, and other parts of Europe. The eggs, larvæ

or pupæ, of many have no doubt been carried across the seas by ships, in the soil round the roots of plants, &c , exported from one part of the world to another; and have thus been introduced into countries of which they were not originally natives, and some species finding suitable food and climate, have become naturalized, whilst others not so favourably situated, occur but rarely in the countries to which they have been transported. As an example of the first of these two cases I will instance *Agrotis suffusa*, which is of wide world distribution, and is tolerably numerous about Montreal, coming to sugared trees on the Mountain, at the end of September and beginning of October; it is a common species in England, appearing there also in September and October, it frequents Ivy-blossoms, &c., and hybernating comes forth a second time in the early spring, and may then be taken at sallow-blossoms and sugared trees; the larva feeds on the roots of grasses, but is not so destructive as some of the other species.

Agrotis subgothica is a good illustration of the second case, it is a very abundant species round Montreal, appearing in July and continuing till late in the autumn. It frequently flies in at the open windows during the summer evenings, attracted by the lights in the rooms. It is very likely produced from these Red-headed Cutworms, but I do not know for certain, as I have never had time or opportunity to trace it through its various transformations. It has occurred a few times in England, but so rarely that it is marked as a doubtful native in the British Museum Catalogue of British Lepidoptera, and is not now admitted into the British Lists. *Agrotis segetum*, a common English species, is sometimes very destructive in that country to young wheat, of which it devours the roots in autumn and spring. Mr. H. Doubleday says it is very troublesome in gardens, often destroying Anemonies, and eating into the roots of Dahlias, &c. It is the larva of this or of one of the closely allied species which often injures the turnip crops, in the autumn to a very great extent, in different parts of England.—See Humphrey and Westwood's British Moths, p. 116. It is not only the genus *Agrotis*, however, which is so destructive to the farmers crops, for several allied genera with similar habits, such as Charæas, Cerapteryx, and Graphiphora, are capable of inflicting severe injury. What devastation *Cerapteryx graminis*, a European species, can cause in grass lands, the following extracts from the work I have just mentioned will show:—" This Moth appears in July and August, occasionally in great numbers in certain

districts, indeed it is recorded that in Sweden, towards the middle of the last century, the ravages of the larvæ were so extensive that whole meadows appeared white and dry, as though a fire had passed over them. In some parts of England spots of a mile square have been observed totally covered by them, and the grass devoured to the root; and Mr. Wailes has recorded in the Entomological Magazine, that in one year at least fifty acres of grass upon Skiddaw, were so completely devastated, and the line of devastation so clearly marked, that even from the town of Keswick the progress of the larvæ down the Mountain could be distinctly noticed. Vast quantities of Rooks flocked to the spot to feed upon the delicious repast afforded by these caterpillars, but so greatly was the vegetation destroyed, that even several years afterwards the extent of their ravages was distinctly visible. 'Of course,' adds Mr. Wailes, 'the quality of the newly grown herbage was materially improved,' thus affording another instance of indirect advantages derived from insects;" Humphrey and Westwood, p. 113. Their ravages were noticed by Linneus, who says they will not eat *Alopecurus pratenis*, *Trifolium pratensis*. This is a good hint to our farmers to enquire whether any species or varieties of grass, wheat, &c., are obnoxious to the American Cutworms, and if any are discovered, by growing them exclusively for a few years, in such places as are most infested by the worms, they would probably in a great measure disappear. Dr. Fitch says that "he does not think the fertility of the soil or the kind of manure which is applied to it, has any influence upon them, excepting in making plants more succulent; for it is vegetation of this character which appears to be their favorite food. We all know these worms are common in our highly manured gardens and I have never found them more plentiful than on one occasion among beans planted upon a hill side so barren that it was thought nothing else could be raised there." In another place he also gives some interesting particulars, extracted from the Albany Cultivator, relative to a Hymenopterous insect, (probably a Sphex) which collects the larvæ to store her nest with them, as food for her offspring.

The history of these insects appears to be as follows:—The Moths come forth toward the end of the summer, and the females deposit their eggs in the ground; these hatch in a short time, and the young larvæ commence feeding on roots of grass, &c., until the frosts of autumn set in, when they bury themselves in

the ground, or seek shelter under stones, whence they emerge as soon as the spring is sufficiently, advanced, and attack the crops almost immediately they are above ground. When the larva is full fed it changes to a brown pupæ at a small depth in the soil, without spinning any cocoon, but forming a smooth cavity in the ground; in a few weeks this produces the perfect insect, similar to those species of which I now exhibit specimens.

It is certainly not very encouraging to the farmer to reflect how many plants they will attack, and here is a formidable list of those to which one or other of the species have been found more or less destructive :—

Cucumbers.—30 sometimes found round one vine.

Cabbages.—Whole fields cut down in a night.

Beans.—Frequently much injured.

Oats.—Fields completely devastated.

Wheat.—Often very much injured,

Indian Corn.—The whole crop sometimes disappears.

Onions.—Occasionally eaten.

Buckwheat.— Do.

Mangold Wurzel.—Much infested.

Turnips.—Occasionally by English species.

Grasses of various kinds.—Meadows sometimes stripped of all vegetation.

Cotton.—In the south, larvæ of the same habits and appearance are very destructive to the young plants.

The only reliable method of destroying the larvæ is to dig them up one by one from the roots of the plants, and this can be done easily enough in the rows of Indian Corn, which is the crop they appear to injure most, at least in this neighbourhood. The labour would be well bestowed, as every larvæ destroyed may be considered as equivalent to at least half-a-dozen plants of corn saved. It is said that by making deep holes in the fields, they will fall in during their nightly wanderings, and being unable to get up the perpendicular sides of the pits, owing to the crumbling earth breaking away under their weight, they are thus easily captured and may be killed at leisure. It is probable that a deep trench kept free from weeds, and in good repair, dug all round the fields, would preserve the crops from attack, but care must be taken before night to remove anything, such as a bridge, boards, &c., by which they might cross.

I will now bring my observations to a conclusion; I fear I have trespassed too largely on the patience of the meeting, but trust it will consider the importance of the subject as some excuse for my prolixity, and the numerous extracts which I have made from the various works I have consulted.

NOTE.—I am indebted to James Logan, Esq., for the dates of sowing of his various crops.

ARTICLE XXI.—GLEANINGS *in the Natural History of the Hudson's Bay Territories, by the Arctic Voyagers.**

The two books of which we give abstracts of the titles below, are the most interesting of all those that have been brought forth as the fruits of that great scientific undertaking, the discovery of the North West Passage. The first contains a narrative of Sir John Richardson's journey by land to the Arctic Sea, in 1848, and his return by the same route in 1849. Sir John left Liverpool on the 25th March, 1848, landed at New York on the 10th April, and arrived at Montreal five days after. At Lachine he was supplied by Sir George Simpson with experienced voyageurs who were engaged as canoe-men for the long journey. On the 29th April he reached Sault St Marie, at the outlet of Lake Superior, on the 12th May, Fort William, on the 18th the summit of the water shed which separates Lake Superior from Lake Winipeg, on the 5th of June, Cumberland House, one of the Company's Stations, situated on the Sascatchewan, and on the 15th of September, Fort Confidence. This station is about three miles from Dease River on Great Bear Lake, in latitude 66°, 54′, north, and longitude 118°, 49′, west.

It is within 100 miles of the shores of the Arctic Sea, and 2530 miles, from Montreal by the route travelled. Here the party remained during the winter of 1848-49, and returned to England in the following summer.

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* 1. *Journal of a Boat voyage through Rupert's Land and the Arctic Sea, in search of the Discovery Ships under the command of Sir John Franklin, with an Appendix on the Physical Geography of North America.* BY SIR JOHN RICHARDSON, LONDON, LONGMAN, BROWN, GREEN AND LONGMANS, 1851.

2. MCCLURE'S *Discovery of the North West Passage, Edited by* CAPT. OSBORNE, LONGMAN, BROWN, GREEN, AND LONGMANS, LONDON, 1857.

Capt. McClure's expedition, it is scarcely necessary to state, was by sea, by Cape Horn through the Pacific Ocean and thence into the Arctic Ocean from the west. He left Plymouth in the "Investigator" on the 20th January, 1850, and was frozen in during the autumn of 1851, on the north coast of Bank's Land, a large island in the Arctic Sea, about half the distance between the two extremes of the passage sought to be explored. Here they remained until April, 1853, when they were discovered by the crew of the "Resolute" under Capt. Kellett, who had entered the passage from the Atlantic side in search of Sir John Franklin.

By Captain McClure and his brave party the most famous problem in the physical geography of the globe has been solved, and though the results can never be made of any great commercial importance, yet, as all new truths contribute to the intellectual advancement and happiness of our race, the labour has not been lost. To such of our readers as feel inclined to explore the frozen regions of the north by their own comfortable firesides, we cheerfully recommend the works from which the following extracts are taken. They are illustrated by some exceedingly good plates of the Indian tribes and of Arctic scenery, and are full of new and entertaining facts. The natural history observations are particularly interesting, and it is from these that we shall make a few selections.

1. *The peregrine falcon*—Sir John Richardson, while descending the Mackenzie River, noticed the nest of a peregrine falcon on a cliff of sandstone rock. This bird is not rare throughout that region where it preys on the passenger pigeons and smaller birds. "Mr. McPherson, says Sir John, related to me one of its feats, which he witnessed some years previously as he was ascending the river. A white owl (*Stryx nyctea,*) in flying over a cliff, seized and carried off an unfledged peregrine in its claws, and, crossing to the opposite beach, lighted to devour it. The parent bird followed, screaming loudly, and stooping with extreme rapidity, killed the owl by a single blow, after which it flew quickly back to its nest. On coming to the spot, Mr. McPherson picked up the owl, but though he examined it narrowly he could not detect in what part the death blow had been received; nor could he from the distance perceive whether the peregrine struck it with wing or claws."—*Richardson, Vol.* 1, *page* 206.

2. *A Hare Indian devoured by a Bear.*—By Mr. Bell, I was informed of the melancholy death of an Indian in the vicinity of

Fort Good Hope. This poor man, having set several snares for bears, went to visit them alone. The event showed that he had found a large bear, caught by the head and leg, and endeavoured to kill it with arrows; several of which he shot into the neck of the animal. He seems to have been afraid to approach near enough to give full effect to his weapons, and the enraged bear, having broken the snare, flew upon him and tore him in pieces. The man's son, a youth of about sixteen years of age, becoming alarmed by the lengthened absence of his father, took his gun, and went in quest of him, following his track. On approaching the scene of the tragedy, the bear hastened to attack him also, but was shot by the lad as he was rushing at him. The boy found his father torn limb from limb, and mostly eaten, except the head, which remained entire. The bear, whose carcass was seen by Mr. Bell, was a brown one, and of great size. Fragments of the snare remained about his neck and leg.

These brown bears are very powerful; and the same gentleman who told the above story informed me that on the Porcupine River, to the west of the Peel, he saw the foot-marks of a large one which having seized a moose deer in the river, had dragged it about a quarter of a mile along the sandy banks, and afterwards devoured it all, but part of the hind quarters. The bones were crushed and broken by the animal's teeth, and, from their size and hardness, Mr. Bell judged the moose to have been upwards of a year old, when it would weigh as much as an ox of the same age. The species of these northern brown bears is as yet undetermined. They greatly resemble the *Ursus arctos* of the old continent, if they are not actually the same; and are stronger and more carnivorous than the black bears (*Ursus americanus*), which also frequent the Mackenzie. The grisly bears (*Ursus ferox*) reach the same latitudes, but do not generally descend from the mountains.—*Richardson, Vol.* 1, *page* 217.

3. *The Musk Ox, Ovibos moschatus.*—The evening proving fine, Mr. Rae and Albert went out to hunt, and both had the pleasure of seeing the musk-ox, for the first time in their lives. The *uming-mak* is known by name and reputation to all the Eskimo tribes; but as it does not exist in Greenland, or Labrador, nor in the chain of islands extending north from that peninsula along the west side of Davis Straits, Albert, who was a native of East Main, now for the first time approached its haunts. Mr. Rae, with the feelings of an ardent sportsman, had longed to en-

counter so redoubtable an animal; and the following is an account of the meeting:—

On perceiving a herd of cows, under the presidency of an old bull, grazing quietly at the distance of a few miles from our bivouack, he and Albert crept towards them from to leeward; but the plain containing neither rock nor tree behind which they could shelter themselves, they were perceived by the bull before they could get within gun-shot. The shaggy patriarch advanced before the cows, which threw themselves into a circular group, and, lowering his shot-proof forehead so as to cover his body, came slowly forwards, stamping and pawing the ground with his fore-feet, bellowing, and showing an evident disposition for fight, while he tainted the atmosphere with the strong musky odour of his body. Neither of the sportsmen were inclined to irritate their bold and formidable opponent by firing, as long as he offered no vital part to their aim; but, having screwed the bayonets to their fowling-pieces, they advanced warily, relying on each other for support. The cows, in the meantime, beat a retreat, and the bull soon afterwards turned; on which Mr. Rae fired, and hit him in the hind quarters. He instantly faced about, roared, struck the ground forcibly with his fore-feet, and seemed to be hesitating whether to charge or not. Our sportsmen drew themselves up for the expected shock, and were by no means sorry when he again wheeled round, and was, in a few seconds, seen climbing a steep and snow clad mountain side, in the rear of his musky kine.

These animals inhabit the hilly, barren grounds, between the Welcome and the Copper Mountains, from the sixty-third or sixty fourth parallels to the Arctic Sea, and northwards to Parry's Islands, or as far as European research has yet extended. They travel from place to place in search of pasture, but do not penetrate deep into the wooded districts, and are able to procure food in winter on the steep sides of hills which are laid bare by the winds, and up which they climb with an agility which their massive aspect would lead one ignorant of their habits to suppose them to be totally incapable of. In size they are nearly equal to the smallest Highland or Orkney *kyloes;* but they are more compactly made, and the shaggy hair of their flanks almost touches the ground. In structure they differ from the domestic ox, in the shortness and strength of the bones of the neck, and length of the dorsal processes which support the ponderous head. The swelling bases of the horns spread over the foreheads of both sexes, but are

most largely developed in the old males. The musk-ox has also, the peculiarity in the bovine tribe of the want of a tail; the caudal vertebræ, only six in number, being very flat, and nearly as short, in reference to the pelvis, as in the human species; the extreme one ending evenly with the tuberosities of the ischium. A tail is not needed by this animal, as in its elevated summer haunts moschetoes and other winged pests are comparatively few, while its close, woolly, and shaggy hair furnishes its body with sufficient protection from their assaults. The fore-pasterns are provided on their outsides with a slender accessory bone, of about half their length. The fossil Irish elk and musk-deer have also rudimentary toes, but of a different form. Though I have not been able to ascertain that the range of the species was ever greater than it is known to be at present, I have read somewhere of a skull having been found in Greenland. One in tolerable preservation, but defective in the nose, was procured by Captain Beachy, from that very curious deposit of bones in the frozen cliffs of Eschscholtz Bay of Behring's Straits. That skull is now preserved in the British Museum, and a perfect skeleton of the recent animal exists in the museum at Haslar Hospital.—*Richardson Vol.* 1, *page* 322.

The general habits of the musk-oxen of the Archipelago resemble strongly those of the reindeer; but they appear to be principally confined to Melville Island, Bank's land and a large island to the south-east of the latter,

None of them were seen alive on Bathurst or Cornwallis Land, although ancient skulls and bones have been found on both shores of Wellington and the Queen's Channel, yet not in very great numbers. One musk-ox was found, in 1851, in Byan Martin Island; it appeared to have died from old age or starvation. Captain M'Clure only obtained three oxen from Mercy Bay, but subsequent visitors to Bank's Land, Captain Mecham and Mr. Krabbé, have seen numbers. Yet, so far as places visited can be taken as an authority upon the subject of their locality, it appears as if the south-west extreme of Melville Island was their favourite haunt, especially that portion of it lying between Liddon Gulf and Cape Russell; and it is worthy of remark, that that portion of Melville Island, although possessing a southern aspect, impinges upon the vast area of never-thawing ice, that "land of the white bear," from whence the west wind appeared to bring such intense cold whilst the "Investigator" was imprisoned against Ballast Beach in Bank's Land.

Commander G. F. Mecham, whose interesting remarks, whilst searching in the above direction, are of great value in many respects, makes the following general observations upon the animals he fell in with in 1853:—

"Game was only procured when required for use, otherwise great quantities might have been obtained on Melville Island. About the sloping land from Cape Smyth up to the head of Liddon's Gulf, animals were seen in great numbers, but particularly about the 115° of longitude, were both in April and June musk-oxen were very numerous. I saw, in a walk overland of ten miles, as many as 150 head of cattle. At Cape Smyth, on June 18th, a perfectly white musk-cow was seen with a black calf grazing with another cow and calf of the usual colour. Only one small herd of reindeer was seen while crossing Melville Island to Winter Harbour in July, as the land was then covered with water, or else in a deep swamp. In June and July, innumerable lemmings were seen both on the land and ice. Those on the latter were frequently carried off by the burgomasters, which were always in great numbers wherever the land was high or steep. At the entrance of Liddon's Gulf two large flocks of snowy geese were seen, but, in general with all the waterfowl, were very wild.

"From the barren state of the soil of Eglintoun and Prince Patrick's Land, I am inclined to think that it is not a very favourite resort for animals. Several traces were seen in May and June on the ice, all travelling *from* Melville Island to the westward. On Patrick's Land we found vegetation only immediately on the south beach, and that only as far as 122° W. Throughout the journey beyond that, until returning again to the southern shore on June 1st, no traces or animals were seen of any kind except two bears off Cape Manning.

"The musk-oxen were all very wild in April, and generally seen in large herds from ten to seventy in number. In June they were stupidly tame, and seemed to be worried with their heavy coats of wool, which were hanging loosely down their shoulders and rumps in large quantities; the herds much smaller, and generally composed of cows and calves.

"At Cape Russell I walked up to within ten yards of two cows and a bull without their taking the least notice of me, and when I fired, only ran about five yards and commenced grazing. The cows were at first butting at the bull, who received their blows with the crown of his horns, which sounded like the meeting of two heavy skittle-balls."

The heavy coat of wool with which the musk-oxen are provided is a perfect protection against any temperature. It consists of a long fine black hair, and in some cases white (for it is not ascertained that these oxen change their colour during the winter), with a beautiful fine wool or fur underneath, softer and richer than the finest alpaca wool as well as much longer in the staple. This mantle appears to touch the ground, and the little creatures look like a bale of black wool, mounted on four short nervous goat-like legs, with two very bright eyes, and a pair of sharp wicked-shaped ho ns peering out of one end of it. Captain M'Clintock, of H. M. S. "Intrepid," gives the following dimensions of some oxen shot by him in 1851, which are a very fair average, the animals seldom exceeding the size of Shetland ponies.

Measurements of Musk-Oxen. Shot at Melville Island in 1851.	Bull.	Bull.	Cow.	Cow	
	ft. in.	ft. in.	ft. in.	ft. in.	The roots of the horns meet over the fore-head, and in the bulls spread out longitudinally, forming a secure shield for the head. In the cows the roots of bases of the horns are much smaller, and are buried in long hair.
From base of horns to root of tail.	7 2	5 $10\frac{1}{2}$	5 2	5 4	
Width of the base of horns measured longitudinally.............	—	0 $11\frac{1}{2}$	—	—	
Base of horns (including their width) to the nose............	1 $10\frac{1}{2}$	—	1 $4\frac{1}{2}$	—	
Hoof to tip of shoulder..........	4 9	4 7	4 $1\frac{1}{2}$	—	
Hind hoof to top of rump........	4 3	—	—	—	
Corner of mouth to eye..........	0 10	0 10	0 9	—	
Round of muzzle above the nostrils.	1 9	1 9	1 7	—	
From one eye to the other........	0 $11\frac{3}{4}$	—	0 9	—	
Round of fore leg, just above the hoof (fetlock?)...............	0 7	0 $7\frac{1}{2}$	—	—	
Width of fore hoof.............	0 $4\frac{1}{2}$	0 $4\frac{1}{2}$	0 $3\frac{3}{4}$	—	
Its circumference...............	1 4	1 $3\frac{1}{4}$	1 1	—	
Width of hind hoof.............	0 $3\frac{3}{4}$	—	0 $3\frac{1}{4}$	—	
From tip to tip of horns.........	2 8	2 $3\frac{1}{4}$	1 $3\frac{1}{2}$	—	
Length of each horn............	2 3	2 0	1 7	—	
Length of tail..................	0 2	—	0 $1\frac{3}{4}$	—	

They seem to be of very uncertain temper, sometimes standing stupidly glaring at their assailants, whetting their horns against their fore-legs; and at other times our sportsmen had to be quick in escaping from their fury.

Of their activity when excited, Captain Mecham speaks in another part of his diary, before quoted.

"During our stay, I proceeded to the northward, overland towards the head of Hardy Bay, Melville Island. The land rises to an elevation of about 800 feet above the sea, and nearly all the hills are of a remarkable table shape. Musk-oxen are here in very

great numbers; on one plain I observed as many as seventy grazing within a circuit of two miles; on my approach they divided into herds of about fifteen each, headed by two or three enormous bulls. Their manœuvres were so quick and regular that they were more to be compared to squadrons of cavalry than anything I could think of. One herd advanced several times at a gallop within rifle-shot, and formed in perfect line with bulls in advance, showing a formidable front of horns. The last time they advanced at a gallop to about sixty yards, and formed in line, the bulls at the same time snorting and tearing up the snow. Immediately I fired they wheeled round, joined the main herd, and made off out of sight, only waiting occasionally for the wounded one."

And in Captain L. M'Clintock's sledge journey along the northern coast of Melville Island and Prince Patrick's Island, he gives a glowing description of an encounter with a noble bull, which we transcribe as it stands in the Blue Book of 1855:—

"We saw and shot two very large musk-bulls, a well-timed supply, as the last of the venison was used this morning; we found them to be in better condition than any we had ever seen. I shall never forget the death-struggle of one of these noble bulls; a Spanish bull-fight gives no idea of it, and even the slaughter of the bear is tame in comparison. This animal was shot through the lungs, and blood gushed from his nostrils upon the snow. As it stood fiercely watching us, prepared, yet unable to charge, its small but fixed glaring eyes were almost concealed by masses of shaggy hair, and its whole frame was fearfully convulsed with agony; the tremulous motion was communicated to its enormous covering of tangled wool and hair; even the coarse thick mane seemed to rise indignant, and slowly waved from side to side. It seemed as if the very fury of its passion was pent up within it for one final—a revengeful—charge. There was no roaring, the majestic beast was dumb; but the wild gleam of savage fire which shot from his eyes, and his menacing attitude, was far more terrible than the most hideous bellow. We watched in silence, for time was doing our work, nor did we venture to lower our guns until, his strength becoming exhausted, he reeled and fell.

"I have never witnessed such an intensity of rage, nor imagined for one moment that such an apparently stupid brute, under any circumstances of pain and passion, could have presented such a truly appalling spectacle. It is almost impossible to conceive a more terrific sight than that which was presented to us in the dying

moments of this matchless denizen of these northern wilds. A mile or two farther we saw four milch cow and a very small calf."

It appears to be doubtful whether the wolf, naturally a most cowardl creature, is able to act in any way offensively against the musk oxen; the general impression amongst the naval officers employed in localities where a good opinion upon the subject could be formed, was, that the wolf would only attack the lame or sickly cattle.

The activity of these oxen, and goat-like power of climbing, is very remarkable, and much at variance with their clumsy appearance. They have been seen making their way, when frightened, up the face of a cliff which defied all human efforts to follow them, and going down the precipitous sides of ravines by alternately sliding upon their hams or pitching and arresting their downward course by the use of the magnificent shield of horn which spreads across their foreheads, in a manner to call forth the astonishment of the beholder.

4. *Non-migration of the Arctic fauna.*—It will not here be out of place to throw together the observations generally collected upon the habits of those two important animals for the Arctic navigator, the reindeer and musk-ox. The facts are spread over a great amount of journalising, but the writer, anxious to place on record the new information gleaned, has here given it, premising that he is no naturalist, and that he alone is responsible for the non migration theory, having been nearly excommunicated as a heretic in 1851, for first giving utterance to it at Griffith's Island. Now that the trustworthy records of the voyages of Captains M'Clure, Austin, Kellet, Penny, and Kane, have put us in possession of many facts connected with the movements of the oceanic ice up to a very late period in the year, in different parts of the arctic archipelago, we are able to see that the statement of an autumnal migration of the herbivorous animals, to the Continent of America, for the purpose of avoiding the rigours of an arctic winter, is no longer tenable.

The great winter drift, in 1849 and 1850, of Sir James Ross and Commander De Haven from Barrow's Strait and the top of Wellington Channel, proved that the ice around those lands was in motion long after winter had set in, and that at the season of utter darkness, those wild seas were churning and rolling on in their mysterious course to south latitudes. We have seen since then, that the ice beset the "Investigator" in Prince of Wales

Strait, and Capt. Kellett's squadron in Melville Sound were not stationary until the close of November; and long after that period during spring-tides or in strong gales, there was abundant evidence that large spaces of water and weak ice existed around them; such, in short, as would be quite sufficient to prevent timorous deer or musk-oxen attempting a journey which would have puzzled even an amphibious animal. Additional testimony abounds elsewhere; the ice of Queen's channel and around the winter quarters of H. M. S. "Pioneer," in Northumberland Sound (1852-53), was even so weak, or else so heavily packed, at the end of the winter, that it could with difficulty be traversed by our men; and near Dr Kane's winter quarters, in Smith's Sound, the ice was either so treacherous or so piled up, that his parties could not cross it from Greenland to the western coast.

All this betokened insuperable difficulties in the way of an animal migration, simply from the absence of a highway for the poor brutes to pass from 78° to 68° North latitude, a distance of about 600 miles straight as the crow flies. Then we had the fact of the reindeer wintering in Greenland; for not even the most profound believer in an animal exodus had ever accused the poor creatures of embarking on the bosom of the waters of the Atlantic or Davis's Strait, and proceeding in the autumn to Labrador; moreover, we knew that the Dutch and Russian fishermen wintering in Spitzbergen in the old time, found the reindeer always there; at last, further doubt upon the subject was removed by the abundant testimony which poured in upon us between 1850 and 1854; and the question is now placed beyond all doubt that the deer, musk-ox, hare, and lemming of the arctic archipelago dó winter in those islands.

This work not being a disquisition on natural history, it would not interest the reader to quote at length all the passages upon the subject from the different journals of officers lately engaged on artic service; some remarked one fact, others another; so that by plodding over the ponderous blue-books, a very fair collection of data may be collected. Our gleanings are as follow:—

In the depth of the winter of 1850-51, deer, or recent traces of animals, were seen near the respective winter quarters of Captain M'Clure, Captain Austin, and Captain Penny; and in the early spring of 1851, when the temperature was 40°—, Lieut. Aldrich observed reindeer, white as driven snow, grazing upon what he described as stony plains covered two feet deep with snow, and

the animals so lean and winter-pulled, that no one could suppose they had been revelling on the American Continent, and had just rushed up to 76° North to enjoy a low temperature and Lenten fare: they had their young fawns with them, which was an additional argument against a journey which, to and fro, could hardly be less than 2000 miles; and it is as well to remember that distance tells on animals as well as men.

Captains M'Clure and Kellett testify to these animals being found all the winter round, about the spots they wintered in. This narrative contains several remarkable passages, extracted from the former officer's journal upon that head; we will add one more, dated December 1852. "The deer have for the last few days," he says, "been coming from the southward to their winter quarters amongst the ravines and sandhills: ninety have been met with at one time, and forty at another; but they are so wild that few have been shot. Our two seasons' experience shows that these animals do not migrate to the south, as is generally supposed, but bear the extreme rigour of the climate, and exist upon the scanty herbage here found, chiefly that dwarf willow, from off which they break the snow with their feet, and in doing so make a tapping noise that may be heard at a considerable distance when the weather is calm, frequently leading to their discovery by our sportsmen. The hares and ptarmigan have also descended from the high ground to the sea ridges, so that a fair supply of game is brought in."

In 1853, immediately after some months of bitter temperature, the writer landed on the north shore of Bathurst Land, and was not a little surprised to observe that reindeer were very numerous on the uplands: they were browsing, with their last year's fawns, upon a miserable vegetation which any other animal would have starved upon: the only plant which they did not appear to have touched was the saxifrage, notwithstanding that the young shoots or buds are remarkably sweet, and the favourite food of the ptarmigan.

That the reindeer crosses the firm ice of the archipelago in the spring, no one can deny; but it is in search of food, not to avoid a rigour of climate which Nature has provided them with an admirable organisation to meet; but those tracks of deer, and sometimes the creatures themselves, have only been seen going in an easterly and westerly direction, between the islands of Melville, Bathurst, and Cornwallis, upon the one hand, and Melville, Eglin-

toun, and Prince Patrick, upon the other; but never in such numbers as to induce anyone to call it a migration. Deer have never been seen, or any other herbivorous animal, crossing Barrow Strait, or Melville Strait, either going north or south. Having thus disposed of the migration theory, we will next touch upon the general habits of these wonderfully constructed creatures, who, without any coating of blubber like the bear and the seal, are able to pass unscathed through a pitiless winter in a climate ranging, as far as is yet known, from zero to 65° minus, a temperature which strikes like cold steel at the vital powers of a well-clad man, and rends iron and rocks with its resistless power. *McClure's discovery, page* 293.

5. *Habits of the Reindeer.* Their average size and weght approximate mostly to those of the ordinary fallow deer of our English parks. An exceptional case is sometimes seen in some lordly stag who though, like Tennyson's "many-wintered crow," admirably fitted to lead his herd, and forming a very fine object in an arctic solitude, would be uncommonly tough and strong eating any where but in 76° north latitude. They are by no means graceful creatures at any age; the joints are large and powerful in proportion to the size of the animal; the divided hoofs are very large, and from the animal being obliged to raise its feet high when going over the snow, its gallop has none of that beautiful spring which characterises the red deer of our isles, though the pace is a telling one, and soon carries the reindeer clear of anything but the long-winded long-legged wolf.

The stags cast their antlers, and the does drop their young, in May or June, about the time of the first thaws; the males and females are then not often found together, unless it be some gay Lothario, with half a dozen admiring spinsters—an exceptional case however; and the female deer are at this season usually in small herds with their fawns; the little creatures—all eyes, ears, and legs—taking alarm at the slightest appearance of danger. The summer vegetation fattens the bucks and does amazingly, and the fawns grow apace, all three having a comparative holiday, and getting into condition to meet the trials of the coming winter, while the wolf and the fox, their sworn foes, are devoting their kind attention to the infant seals and bears, or attending to their own little domestic duties. Indeed, in the height of the arctic summer, the swampy state of the lowlands and the cutting effect of the stony hills, as shown in the state of our poor dogs' feet and

our own boots, was strong testimony against the wolf or fox being able to do much at that season against hoofed animals. As the autumn frost sets in, and the snow again spreads its pall over the death-like scenery of the north, the wolves are seen hanging in constant attendance upon the unfortuuate deer.

They for protection and warmth, and following the natural instincts of gregarious animals, now commence to troop together, forming large herds of does, bucks, and fawns. Some have been counted numbering 60 head. The stags are evidently responsible for the discipline of these large herds, as well as their safety : upon the latter head, Captain Mecham tells an amusing anecdote.

In October 1852, he was crossing that portion of Melville Island which intervenes between Liddon Gulf and Winter Harbour, and fell in with as many as 300 head of deer; indeed, he says reindeer were always in sight in herds varying from 10 to 60 in number. One of these herds, containing 20 head, he tried to stalk up to on the 7th October, but failed in getting a shot at them; for although the does, with the inherent failing of their sex, were extremely curious, and made one or two efforts to escape from the herds, and examine the "strange gentleman," the stags would in nowise tolerate such conduct, chastised them rather soundly with their antlers, and kept the herd together and moving, by running rapidly round and round, uttering at the same time a strange noise which seemed to alarm the herd, and keep it flying from the suspected danger.

The coat of these creatures, which during summer had become remarkably thin, and adapted admirably in colour to that of the snow-denuded soil, now rapidly thickens and again returns to its pristine whiteness. It is not a fur, in the strict acceptance of the term, but it forms an admirable non-conducting substance.

As winter advances, and food requires to be sought over larger areas, the herds break into parties of 10 to 20 animals; the lichens, a species of tripe-de-roche, the sprouts of the ground willow, as well as Iceland moss, being their principal food. It must be remembered that arctic vegetation has no time in the autumn to wither or decay; whilst in full bloom, and before the juices have time to return into the parent root or be otherwise dissipated, the magic hand of the Frost King strikes them, and thus the wisdom of the Creator has provided, for the nourishment of his creatures, a fresh and warmth-creating food, lying hid under a mantle of snow, which the instinct of those arctic animals teaches them to remove and reach the stores so beneficently preserved beneath.

There is another peculiarity worthy of notice. Most herbivorous animals have a slow system of digestion, even in a domestic state; our cattle and sheep, for instance. This appears to be still more the case in the musk-oxen, reindeer, and arctic hare, and is of infinite use in lands where the vegetation is scanty and wide spread, and the weather occasionally so severe as to oblige these creatures for two or three days at a time to look purely to their own safety by seeking shelter from the snow-storms in deep ravines or under lofty cliffs. It appears in their case as if Nature extracted from their food a greater quantity of nourishment than she does from that of animals in more southern latitudes, or possibly, by remaining in the stomach or intestines, it serves to check the cravings of appetite, although there be no further nutriment to be extracted.

Most of the musk-oxen and deer, the former especially, had their entrails distended with food (apparently quite digested), whilst the country around in many cases was as barren as a macadamised road, fairly leading to the inference that these creatures must have been a long time collecting what they had within them: and that it had been a long time swallowed, and required the vital principle of the animals to be in full activity to prevent the food from becoming a source of disease, was pretty well proved in the case of the musk-oxen, which if shot, and left twelve hours without being disembowelled, became tainted throughout with a strong musky odour rendering the flesh uneatable.

Another strong fact which bears upon the impunity with which these creatures can winter in high latitudes, is that in Lapland, where these reindeer are used for tractile purposes, it is considered quite enough food for a working animal if they are able to give it daily four pounds of lichen (*Cenomyce rangiferina*); and on that dietary a reindeer will be in sufficiently good condition to go occasionally without food for two or three days, and do that without apparent distress.

So far as food is concerned, and an organisation fitted to meet the extreme temperature of the Pole, the reindeer is thus beautifully provided; but its sorest trial must be the constant rapacity of the wolves which are ever hanging round them throughout the winter season. As the season advances the reindeer appears to resign itself to the inevitable social misery; and the cool manner in which a small flock of those creatures may be seen grazing with an *entourage* of half a dozen hungry wolves was very strange, and evinced great philosophy, to say the least of it.

A herd of deer thus surrounded by the wolves, who were too great cowards to rush in upon their prey, would be startled every now and then by the long-drawn unearthly howl of the hungry brutes: sometimes a frightened deer, horror-stricken at the abominable chaunt, dashes madly away from the herd,—away all, or a portion of the wolfish fraternity go after it. In many cases, the scene may be briefly summed up with the old three-volume *dénouement* of—a rush—a shriek—a crunching of bones, and snarling of beasts of prey—and all is over! for the wonderful powers of swallow and horrid voracity of an arctic wolf must be seen to be understood; no writer would peril his reputation for veracity by repeating what has been seen on that head. But sometimes the frightened deer gains the open country, and goes wonderful distances dogged by the persevering wolf, who assuredly has it, unless another herd is met which admits the hunted deer into its ranks.

Occasionally, whilst a herd of deer are grazing, one of them may happen to hit upon a spot where the food is plentiful; it naturally lingers there, whilst the herd is moving slowly on against the wind. The wolves immediately mark the straggler, and stealthily crawl on, their object being to cut him off from the herd: that effected, there is a howl and rush, which if the deer do not evade by extraordinary exertions, his fate is instantly sealed.

All through the winter these scenes go on, scent serving the creatures when sight is useless; and many a sportsman, in the December darkness of the Bay of God's Mercy, has often wished his olfactory nerves were as sensitive as those of the wolf, for although he could hear the deer, it was then impossible to see them, unless they moved over the dark yet snowy landscape; and many a bad shot was made by a hungry man at a large pair of sorrowful eyes which loomed out of the mist around, because he did not know whether the deer was two or twenty yards from him.

During the depth of the severe winter of 1852-53, the deer approached close to the "Investigator:" of course in doing so they quitted the land. Whether this was done with a view of seeking the warmth which instinct, if not scent, told them was being given out by the ships, which were like perfect volcanoes of heat, compared to the bitter temperature everywhere prevailing—95° below the freezing point of water—or whether it was for security against the wolves, it is difficult to say, but most probably from the former

cause; for we remember that the foxes of Leopold Harbour, in 1848, soon ascertained the fact of the warmth thrown out by the squadron under Sir James Ross, and wisely burrowed and bred in the embankments thrown up around the ships.

Winter, with its sore trials, has of course its limits; and it is astonishing how early in the new year relief comes to the harassed reindeer. In February and March the seals are breeding, and their helpless young are luscious morsels, that now commence to distract the attention of all the beasts of prey—none more than the wolf—the reindeer's holidays then commence: indeed, we must always remember that the arctic hare and lemming likewise winter in the far north, and yield occasional meals to wolf and fox.

As spring advances, the herds gradually disperse, and the deer may then be seen in twos or threes, until as I have before said, the autumn again approaches. *McClure's Discovery, page* 296.

6. *The arctic hare* (*Lepus Glacialis*) collects in herds or troops during the fall of the year, in the same manner as the deer. Two hundred of them have been seen at a time; and at one of their favourite haunts, Cape Dundas, Melville Island, a complete high way, three yards broad, was seen, the tread of their numbers having beaten the snow perfectly hard. In winter they burrow under the snow for protection, as well as to seek their food. Captain M'Clintock says, "they are every where found, but of course most numerous where the pasture is most abundant, as on Banks Land and Melville Island." The sportsmen of the "Resolute" and "Intrepid" shot 161 hares in a twelve month on the latter Island; their average weight when fit for the table was 7lbs. and from 10lbs. to 12lbs. with skin and offal. During summer the hare, as well as the lemming, seeks protection from beasts of prey under large boulders of rock or in the face of rocky ravines. The hares in summer have seen in groups of from twelve to twenty in number. Their skin is so delicate that although the winter fur is very beautiful, and the colour a brilliant white, it cannot be applied to any useful purpose. They do not hybernate, and, strange to say the Investigators generally found them amongst the heavy hummocks of the floe-ice in Mercy Bay, as if flying to that rugged ground from the wolves or foxes. They differ from the European hare, in bringing forth five or seven young at a birth. *McClure's Discovery page* 317.

That interesting little creature, of the order Rodentia, the arctic lemming. (*Myodus Lemmus*)—a perfect diamond edition of the

guinea-pig—is very like the hare in its habits, but is generally found in large families. They have been seen at all seasons, and in winter are perfectly white; but feeding and living as they do under the snow, it is only the keen-nosed fox, or Esquimaux dog, that can detect their position and enjoy the sweet morsel they afford.

In summer, generally about the end of May, or early in June they have a peculiar habit of going off the land on to the frozen surface of the sea. They do not seem to have any definite object in doing so, and cannot be said to be migrating. Possibly the thaws induce them to leave the land: the seamen, in their quaint way, used to say, "Them blessed little lemmings must be arter salt, I should think, Sir!" and really there seemed to be no other way of accounting for their presence on the floe at such a season of the year. The writer often found them steering off shore from the north coast of Melville Island, leaving comparative plenty behind them, and as far as the eye could see on a clear day, from land of considerable height, there was nothing in the shape of terra firma whither they were bound. When thus exposed upon the open floe, owls, gulls, and foxes pick them up for food. Can it be that Providence occasions this exodus for the purpose of feeding these creatures, and thinning down the numbers of an animal which would otherwise multiply exceedingly, and eat up all the vegetation of a naturally sterile region?

One would hardly suppose so tiny a creature would serve as food to such large animals as Polar bears, but that it is so, the following extract from my journal will show; the place referred to being a valley on the north-east side of Bathurst Land *debouching* into Queen's Channel:—

The White Bear—Saw some shoals and the *Cub* and *Bear* Islets to seaward. Made sail to a rattling breeze, and favoured by the ice, we went along at a good pace until 3h. 30m. A.M., when, seeing some drift-wood lying about, which it was important should be examined, I halted and encamped, dispersing the men along the beach to bring all in they could find. Walking landward to obtain a view from a hill, I was startled to see a she-bear and two cubs some distance inland. Watching them carefully, I was not a little interested to see the mother applying her gigantic muscular power to turning over the large blocks of sandstone which strewed the plain, and under which the unlucky lemmings at this season take shelter. Directly the she-bear lifted the stones, which

she did by sitting upon her hams and pulling them towards her with her fore-paws, the cubs rushed in and seized their prey, tossing them up in the air in their wantonness. After repeating this operation until the young fry must have made a very good meal, I was glad to witness the bear's mode of suckling her young, a sight, I should think, rarely seen. Seated on her haunches, with the backbone arched, so as to bring the breasts (which were situated between the shoulders) as low as possible, the youngsters sucked away in a standing attitude. Anxious to secure this family party, we proceeded to burn all sorts of strong-smelling articles; and at last she brought her babes down, though very warily, and when more than 100 yards off turned away, evidently suspicious. Following her I contrived, at about 150 yards, to pass a ball (Minié) through her body, abaft the shoulder. The cubs at once made off, though I should think they had not long been born, being about the size of an Irish retriever. Joined by a couple of the men (Hall and Wicketts) who soon outstripped me, we eventually, after a long chase, came up with her; the brute, seeing she could not escape, had apparently made up her mind to wait for us behind a range of hummocks. When close to her, I learnt that they had one shot each left in their guns; and as the men longed to go in at her, we walked up, the brute most artfully hiding her body so as to get us within reach for her rush. The wonderful similarity of colour between the fur of the bear and the snow, facilitated her manœuvre, and we were within thirty yards of her when she rose. It was a ticklish moment, for the brute was venomous from desperation. The men behaved very coolly, however, merely saying to one another, "Steady!" Hall fired, but only grazed her; she still came on, when Geo. Wicketts, with my Minié (which I thought he was fully entitled to fire after so successfully bringing the brute to bay), struck her smartly in the fore shoulder. With a snap of the teeth, which it was satisfactory to know was not on ourselves, she turned round, and staggering along, fell into her lair again; and we returned to the boat to send after our dinner the small sledge for the blubber.

The she-bear was miserably lean, nothing in her stomach, and her skin in poor condition. Whilst they were skinning her, the poor little whelps ran up to be suckled; the men tried to catch them; failing in that, knocked their brains out; their little stomachs were perfectly distended with the unfortunate lemmings, which they had swallowed entire.

Perhaps the most curious fact of all, connected with the existence of animal life in high latitudes during the most severe temperatures, is that some ptarmigan are found throughout the winter in Melville Island and Banks Land. I might also add, that they have likewise been seen by officers who wintered at Beechey Island; where a small covey was flushed in the depth of the winter 1852–53. But it is best on this point to give the remarks of an officer who has had admirable opportunities of observing the fact—Captain F. L. M'Clintock, R. N.: he says:—

"The willow grouse never goes north of Bearing Island, the common ptarmigan (*tetrao lagopus*) is the only bird of that species found on Melville Island. They are most numerous in April, generally in pairs, and in September they collect into coveys, sometimes of as many as fifteen or twenty birds, previous to a flight southward. After that month a few were seen, and those were birds which probably had not paired during the previous season. Some ptarmigan were shot in January and February, in excellent condition; of these the largest weighed 2½ lbs., and its crop contained 2½ ounces of the slender shoots of the dwarf willow; many of these shoots were as thick as a crowquill, and ¾ inch long; when ready for cooking, the bird weighed 1¼ lb.; no starveling this! Six hundred and eighty-four ptarmigan were shot on Melville Island in twelve months, by the people of the 'Resolute' and 'Intrepid,' being more than the Investigators got altogether." There is reason to believe that these hardy birds burrow under the snow for warmth, protection, and food, as the hare and lemming do. *Mc Clure's Discovery, page* 17.

RECENT GEOLOGICAL DISCOVERIES.

(*Supplement to the Fifth edition of Lyell's Manual of Elementary Geology.* London: 1857.)

There is no pause in the progress of geological knowledge. The very old in the earth's history is perpetually producing things very new to science. It is "a philosophy which never rests, its law is progress, a point which yesterday was invisible is its goal to-day, and will be its starting point to-morrow." In accordance with this, the motto of his fifth edition, Sir Charles now presents to us a supplement of 34 pages, including a startling amount of new discovery, to some of the more important items

of which we desire to introduce those of our readers who may not yet have learned them from other sources.

First, the later Tertiaries have yielded some new facts, tending to settle the perplexed questions as to the succession of climatal changes and vicissitudes of animal life in those later geological periods which immediately preceded the advent of man; and to which our Canadian boulder clays and sands, with their marine shells, fishes, and elephantine remains, belong.

In the three later tertiary (Pliocene) deposits in England, known in ascending order as the Coralline, Red, and Norwich Crag, the marine shells show a constantly increasing percentage of recent and at the same time of northern forms; and this has just been brought forward in a precise form by Mr. Wood in the publications of the Palaeontological Society. The associated remains of land animals, however, do not appear to correspond with the gradual refrigeration indicated by the shells. This difficulty, long of a very perplexing character, is now beginning to be removed by the progress of discovery. In the first place, the sea of the Arctic shells has probably been open toward the north, while the land lay toward the south. In the next place, it has been found that the mammals of the earlier of these periods differ from those of the later. The Mastodon of the Crag is not the *M. Angustidens* of the Miocene or middle tertiary, but a distinct species. This Crag Mastodon is older than two species of elephant, a rhinoceros, a hippopotamus, and a monkey, found in Pliocene deposits in the Valley of the Thames; and these last are still older than certain ochreous gravels in the same neighbourhood, which contain remains of a third elephant, a second rhinoceros, the reindeer, &c.

Here, then, we have three distinct sets of Pliocene mammals, and the last only consists of animals properly arctic or sub-arctic. The elephant and rhinoceros (*E. Primigenius* and *R. Tichorinus*) are those found in Siberia, and known to have been covered with hair, and they are associated with bones of the reindeer and musk-ox. The discovery of this last animal is of great interest. It is now confined to Arctic America, but in the newer Pliocene period it lived in Germany and in England, along with the reindeer now its arctic associate, and with the hairy elephant and rhinoceros now extinct. Prof. Owen truly remarks, that just as naturalists could hardly credit the possibility of an elephant having lived in Siberia, until they found that it had been protected

by hair and wool, in like manner, the musk-ox, or more properly musk buffalo, is allied in its structure to the buffaloes of the warmer latitudes; and if nothing but its bones had been known, might have been supposed to indicate a sub-tropical climate. Then again, our knowledge that this creature actually lives in the extreme North, confirms our belief that the creatures once its contemporaries, notwithstanding their relation to tropical animals of our day, were suited to a cold climate.

Why is the musk-ox now confined to Artic America, and why have its gigantic associates disappeared? No satisfactory explanation can be given. We only vaguely know that these changes have been connected with differences of climate, apparently depending on a different distribution of sea and land from that which prevails at present.

These conditions alone do not, however, present a sufficient explanation. The climate of the temperate regions of the Northern hemisphere was then colder than now. But there had been a milder climate previously, in the earlier part of the Pliocene period. Thus the time of the Siberian Mammoth and European Musk-ox stands between two milder climates, differing from each other entirely in their terrestrial fauna, but still presenting many features in common in that of the sea. When, in the present world, we pass from the Eastern continent to corresponding climates in the Western, we find different assemblages of land animals, but many identical species of sea shell-fish. It is the same when, in gelogical time, we pass downward beyond the cold period of the later Pliocene, to formations deposited under a climate more like the present. Such facts illustrate the comparatively limited range in time and space of most of the higher inhabitants of the land, and the almost prodigality of the creative power in the introduction of new forms of animals; but they also show that there are in the adaptation of species to climate and other conditions of existence correlations and adjustments too nice for our imperfect means of investigation.

It is strange also that the Musk-buffalo, clumsy and short-legged, should have survived so many nobler creatures, and continued to exhibit his ungainly form, ferocious temper, and unpalatable flesh, an unattractive remnant of that Pre-adamite fauna that was swept away from the old world to make room for man. Perhaps he owes his exemption from their fate to the hardy constitution and warm covering that enable him in his present north-

ern solitudes to eschew the lowland plains and thickets, and haunt the bare bleak hill-sides, which, exposed and barren though they are, suit better his short limbs, and enable him from a vantage ground to resist his enemies. His form of limb, too, appears to be especially adapted to climbing the precipitous heights which are his favorite resorts.

Passing over some new views of the sub-divisions of the tertiary series, and other items of tertiary geology, we come to the announcement that in the space of a few months, remains of seven or eight genera of mammals have been discovered in the Purbeck or Upper Oolite strata of England, and this in one small bed five inches thick, and in a very few square yards of that bed.

Hitherto the whole secondary series had yielded since 1818, when the first mammalian jaw was found in the Stonesfield slate, only six species of small mammals. Thirteen, or twice as many species have all at once appeared from this little bed of the Purbeck. The fact is significant as to the danger of deciding on what was *not* in by-gone periods. No rocks have been better explored than the secondary rocks of Western Europe. They have yielded great numbers of the bones of reptiles and fishes, yet in 36 years only six small mammals had been found. The Purbeck series itself had been carefully examined by the late Edward Forbes, and by the Geological Survey, as well as frequently ransacked by collectors, and had afforded no trace of mammals; and now all at once it proves most prolific of them.

But what manner of mammals are these ancient creatures? not huge pachyderms, like those of the tertiary era which succeeded them, but small creatures, none of them larger than the hedge hog. The greater part are insectivorous, or at least preys on small animals; two species herbivorous, with a peculiar rodent dentition, resembling that of the Kangaroo-rat of Australia. The greater number of these little animals were probably marsupial or pouched, like the prevailing quadrupeds in Australia, but some others have apparently been placental, like our ordinary mammals. Among the latter is a little creature which, according to Prof. Owen, must have been a diminutive example of that type of hoofed animals to which the hog and peccary belong.

One of the results, and not the least curious, of the Purbeck discoveries, is, that the little Microlestes, of the German Trias, the oldest known mammal, must have resembled the two Purbeck species of "Plagiaulax," which are related to the Kangaroo-rat.

This Australian animal therefore, remarkable for having its false molars developed into broad grinding-teeth, different in form from the true molars, is the representative of the oldest known type of mammalian life.

On the one hand, these discoveries show that many species of mammals must have existed in the Oolitic period. On the other, the predominance of Marsupial and Australian forms, along with the great abundance and variety of contemporary reptilian life, leads to the belief that the mammals occupied a subordinate place, and that we are really approaching the time of their introduction upon the stage. A question, however, arises here, and is plainly stated by Sir Charles, which writers on this subject have too often ignored.: How far is our knowledge of a general character? and what do we know of the contemporary condition of portions of the earth to which these discoveries do not apply?

"The advocates, however, of the doctrine of progressive development will offer a different explanation of the phenomena. They will refer the large admixture of marsupials in the Stonesfield and Purbeck fauna to chronological rather than to climatal conditions,—to the age of the planet rather than to the state of a portion of its dry land. In the Triassic and Oolitic periods, they will say, the time had not yet come for the creation or development of more highly organized beings. Experience must test and determine the soundness of these theoretical views. In the meanwhile, it may be useful to bear in mind that while Australia supports at present 100 species of marsupials, the rest of the continents and islands of the globe are tenanted by about 1,700 species of mammalia, of which only 46 are marsupials (namely, the opossums of North and South America), and in like manner there flourished in the Pliocene period throughout Europe, Asia, and America, so far as we yet know, a placental fauna, consisting of species now for the most part extinct, which was coeval with the extinct Pliocene marsupials of Australia. Such facts, although far too limited to enable us to generalize with confidence, seem rather to imply that at certain periods of the past, as in our own days, the predominance of certain families of terrestrial mammalia, has had more to do with conditions of space than of time, or in other words, has been more governed by geographical circumstances than by a law of successive development of higher and higher grades of organization, in proportion as the planet grew older."

Data are wanting to supply the full answer to such a question; and we are too apt to forget that the geological history is rather that of the existing continents and their shores than of the whole earth. Still the facts that we possess strongly indicate that lower and more general types of life once abundant, widely extended, and fitted for varied and high places in the scheme of nature, have shrunk within narrow limits in space, number of species, and range of adaptation, as higher or more specialized types were introduced. The Brachiopod shell-fish and Ganoid fishes of the Palaeozoic rocks, and the Cephalopoda and reptiles of the Mesozoic period, are cases in point; and in like manner, the mammalian types now prevalent in Australia, may once have been general, just as the few ganoids of our modern rivers are little more than memorials of a perished race. Nor need we be surprised if the Marsupial mammals should hereafter be found to have presented in the Secondary period grander or more varied forms than the modern or Pliocene Kangaroos and their associates; and under the same law, we may place the reported discovery, if authenticated, of a tertiary ape more nearly allied to man than any of its modern congeners.

We have not advanced sufficiently far to see the whole of truth in this matter; and the relative importance of space and time, and the true value of types of structure in living beings, require to be carefully weighed; yet these discoveries serve at least to inspire the hope that we shall some day attain to grand and solid general conclusions on the plan of the succession of living beings as gradually developed in the history of the world.

A curious circumstance connected with the discovery of mammals in Secondary rocks, is that nearly all the remains found have been lower jaws and teeth. The number of lower jaws exhumed has been between forty and fifty. With these have been found five upper jaws and one portion of a skull, snd detached bones perhaps sufficient to complete four or five skeletons. To what circumstance does the lower jaw owe its special exemption from destruction? or, is the whole simply one of those accidents that show us how little completeness there can be in our knowledge of fossils? Sir Charles remarks on this point:—

"As the average number of pieces in each mammalian skeleton is about 250, there must be many thousands of missing bones; and when we endeavour to account for their absence, we are almost tempted to indulge in speculations like those once suggested to

me by Dr. Buckland, when he tried to solve the enigma in reference to Stonesfield :—" The corpses," he said, " of drowned animals, when they float in a river, distended by gases during putrefaction, have often their lower jaw hanging loose, and sometimes it has dropped off. The rest of the body may then be drifted elsewhere, and sometimes may be swallowed entire by a predaceous reptile or fish, such as an icthyosaur or a shark."

" We may also suppose that when fish or other aquatic animals attack a decaying carcass, whether it be floating or has sunk to the bottom, they will first devour those parts that are covered with flesh. A lower jaw, consisting of little else than bones and teeth, will be neglected; and becoming detached, may be drifted away by a current of moderate velocity, and buried apart from the other bones in sand or mud."

There is much probability in the last explanation. Cats generally refuse to eat the heads of rats, the skulls of which may often for this reason be seen lying detached in places frequented by them; and in the castings of owls, we often find the lower jaws of mice and squirrels, that have escaped fracture and digestion better than the other bones. Small predaceous mammals or reptiles, perhaps even birds of similar habits, may have left these jaw-bones on the shores of the Purbeck lakes or estuaries, or of the rivers which flowed into them.

To pass from animals to plants, we are informed that a specimen of one of those flower-like fossils rarely found in coal measures, and hitherto of uncertain nature, though supposed by Dr. Lindley and others to be flowers, has been recognized by Mr. Bunbury and Dr. Hooker as actually a spike of blossoms, resembling those of the family Bromeliaceæ, to which the Pine-apple belongs; but it is not this particular genus that the fossil resembles. It is something to have a flower handed down to us from the carboniferous period. We can now add to our picture of the coal swamps a few bright flowers, to relieve the general sombre green of ferns and pines; and are even at liberty to hope that we may discover a butterfly that flitted amongst these ancient blossoms.

Silurian geology contributes its quota of new matter, in the views of M. Barrande respecting "Colonies" of fossils, or in other words, alternations of beds, containing the fossils of a former and later period, at the confines of the range of the new forms, where they were gradually gaining on the older, but where in the

progress of the struggle, they were in turn displaced. The changes in the occupancy of a given area in the sea bottom, must often have been of this character; and where the facts can be ascertained, they form good illustrations of the slow and sometimes interrupted manner in which new faunas, spreading from their centres of creation, have extended themselves over the earth.

M. Barrande regards the oldest or "Primordial" fauna of Bohemia as equivalent to the English "Cambrian" and to our oldest "Silurian" beds in America. Murchison, we rather think, will claim them as the lower members of his kingdom of "Siluria."*

J. W. D.

ARTICLE XXII.—*Description of some of the Fresh-water Gasteropoda, inhabiting the Lakes and Rivers of Canada.*

In the following article we have transcribed from several works descriptions of nearly all the mollusca of the family LIMNÆADÆ that are to be found in the fresh waters of Canada. Their shells are more or less abundant along the shores of all the lakes, ponds, or rivers of the country, and also constitute those valuable deposites known as shell marl. One of these beds of marl may be seen in the suburbs of the City of Montreal, where it has been laid open in the ditches crossing the Lachine Railway. Seven or eight of the species hereinafter described may be procured at that locality. In the ponds at the quarries east of the city, some of the Limneæ and Physæ are also plentiful. We have not seen the large species, *L. Stagnalis*, in this vicinity; but near the City of Ottawa, it is common in the Rideau river and canal. The figures given below are copied from an English work, but they represent our species very nearly. A few days since we showed some of the Canadian specimens to a naturalist from Britain, then on a visit here, and he said they were scarcely to be distinguished from those common in the ponds and ditches in England. Ours is not quite so much angulated upon the upper part of the whorl.

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* Since the above was written we have found that a second edition of the supplement has appeared, containing other new facts among which is the discovery of mammals in the secondary rocks of America.

Genus LIMNÆA, Lam.

Shell thin, oblong or turreted, last whorl large; aperture large, rounded before, narrowed and acute behind, outer lip sharp, inner lip forming a fold on the pillar, and usually spreading over it. Animal with short, triangular tentacula.

Limnæa Stagnalis.—(Linn.)

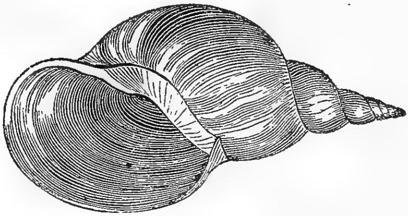


Fig. 1.

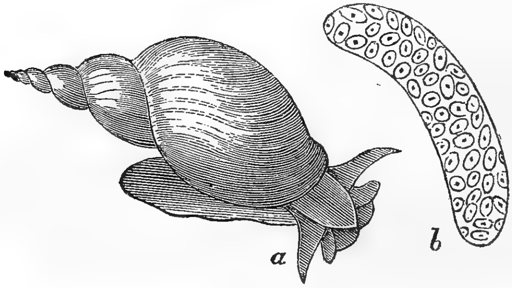


Fig. 2.

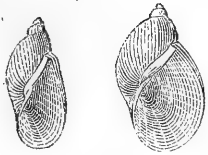
Fig. 1.—The empty shell.
Fig. 2, *A.*—The animal in the shell.
B.—Mass of eggs magnified.

Our shell is about two inches long, the aperture being nearly one-half of the total length. It consists of five or six whorls, of which the four uppermost are slender and tapering to an acute point. The body of the whorl is as large as represented in the figures. There is a conspicuous fold on the inner lip.

This is by far the largest Limnea known in Canada, and is easily recognized by its superior size alone. *

* The remainder of this article is copied from Gould's Invertebrata of Massachusetts.

LIMNÆ'A COLUMELLA.—(Say.)



Shell ovate, ventricose, extremely thin and fragile, transparent, of a pale-greenish or yellowish color, the apex acutely pointed; whorls four, of which the last is much inflated, and composes nearly the whole shell; the upper ones are very small, forming an acute apex; surface with conspicuous and nearly regular lines of growth, minutely waved by revolving lines, some of which are distinctly elevated; suture slightly impressed; aperture large, four fifths the length of the shell, generally somewhat dilated; lip very sharp, ending with a small curve behind; on the left margin the edge is slightly turned over a minute umbilicus, and forms a considerable fold; a thin, closely adhering enamel stretches across from it to the angle of the aperture; the inner lip is so arched as to display a considerable portion of the interior of the shell. Length $\frac{8}{10}$ inch, breadth $\frac{5}{10}$ inch, divergence 68°; of another specimen, length $\frac{13}{20}$ inch, breadth $\frac{4}{10}$ inch, divergence 56°.

Inhabits stagnant pools and miry places, and is common. It is found at maturity very early in the spring.

The *animal* is large, semi-transparent, of a dusky or light-drab color, dotted with silvery white. It is very sluggish in its motions. The head above is slightly tinted with lilac.

This very brittle shell has rather the aspect of SUCCI'NEA, than of LIMNÆ'A. It varies a good deal in form, being in some specimens rather slender, and in others broad and distended. The aperture is usually somewhat dilated, especially at its broadly-rounded base; but occasionally the outer lip is pressed inwards. The surface is shining, and delicately corrugated by revolving lines.

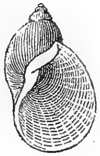
Var. CHALY'BEA. Fig. 145.

The spire is more pointed, its divergence being only 50°; the aperture is more expanded, and the fold on the inner lip more obvious. It is thin, but not very brittle, ringing like hard-burnt crockery. The last whorl is particularly detached from the preceding one, so as to form a thread-like channel at the suture. The enamel rests loosely against the shell, and is wrinkled. The exterior is covered by a bluish-black pigment, not easily removed, and the interior has a steel-blue or black-lead color.

This shell, which I found two years in succession in a muddy

pool in Cambridge, I thought was sufficiently distinct to be regarded as a new species; and I accordingly gave its characters under the name of *Limnæ'a chaly'bea*, in Silliman's journal, xxxiii. 196. But as it has not been found in any other place, I am now disposed to regard it as a strongly marked local variety of L. *columélla*. It is very possibly such a shell to which Mr. Say alludes in the "Journal of the Academy of Natural Sciences," ii. 167, as "L. *columélla*, var. a. small, black, from Cold Water Creek, Missouri."

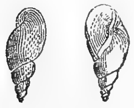
Limnæ'a Macrostoma.—(Say.)



Shell fragile, pellucid, light horn-colored, ovate-conical; last whorl very large, moderately inflated, surmounted by three very small, oblique ones, forming an acute apex; surface shining, marked by fine lines of growth, which are crossed and rendered flexuous by numerous revolving lines, faintly visible without a magnifier; suture distinct, the whorls approaching it by a gradual slope; aperture ovate, very ample, four-fifths the length of the shell, and, when mature, broadly expanded; outer lip very sharp and thin, broadly rounded in front, and, maintaining its sharp edge, it rises and disappears within the shell: pillar so broadly arched as to allow a view of much of the interior of the spire; a minute umbilicus is formed by a reflected scale of enamel; in mature shells a glazing of enamel is found upon the preceding whorl as it encroaches upon the aperture. Length $\frac{11}{20}$ inch, breadth $\frac{7}{20}$ inch, divergence 73°.

This shell is closely allied to L. *columélla*, and in an immature state is not easily distinguished from it; but that shell is much more elongated, and regularly tapering, the divergence of the spire being not more than 60°. Such specimens Professor Adams described as his L. *acuminàta*. But at maturity the shell is very distinctly characterized by its widely spreading outer lip, which gives great expansion to the aperture. Mr. Say received it from the rice-fields of Carolina. It is the analogue of the L. *ovàtus*, of Europe.

Limnæ'a Desidiosa.—(Say.)



Shell ovate, thin and fragile, the spire elongated and turreted; color a pale, dirty yellowish-green; whorls five, very convex, and for the most part suddenly contracted above, so as to present a conspicuous shoulder; the two or three uppermost whorls are

very small, and the body whorl about seven tenths the length of the whole shell; surface generally dead, and somewhat checked with irregular revolving and longitudinal raised lines; aperture large, usually three fifths the length of the shell, oval, broadly and sub-equally rounded both behind and before; the lip is considerably everted in front, and along the left margin, where it is not closely appressed to the whorl, and leaves a small, but evident umbilical opening; callus rather abundant; fold on the pillar slight, and smoothly rounded. Length $\frac{1}{2}$ inch, of aperture $\frac{3}{5}$ inch, breadth $\frac{9}{40}$ inch, divergence 45°.

This species is found in most regions, about the muddy margins of ponds and pools.

It is intermediate between L. *elódes* and L. *modicéllus.* Its spire is proportionally more slender, its suture deeper, its aperture proportionally larger and more oval, the fold of its columella much less conspicuous, and it is a much more fragile shell than the former. The latter, while it has the large, oval aperture, the deep suture and shouldered whorls, is still more fragile, of a deep green-color, and is a short, inflated shell, with a much greater divergence of the spire, and with one whorl more than L. *desidiósa.* The habits of the two last are similar, but the animal of *desidiósa* is a much lighter green, and has not the remarkable white dots between the tentacula.

The characters of the aperture and spire seem to be constant; that is, the aperture is always large and broadly rounded behind; and the spire is tapering, the two whorls at the tip seeming somewhat as if superadded? so that if a line should pass down one side so as to touch all the whorls, this line would be concave. The only variations I have noticed are, that the suture is sometimes shallow, and the shoulder nearly wanting, so as to render the spire more regularly tapering. Mr. Say's description is not definite, and his figure is much shorter than the dimensions he ascribes to it. He gives its length seven tenths of an inch, while it rarely exceeds half an inch.

LIMNÆ'A ELODES.—(Say.)

Shell tapering, elongated, turreted, thin and fragile, dull and dingy horn-colored, inelegant; whorls five, or a little more, the two smallest being generally broken off; they are regularly and largely convex, not flattened or compressed posteriorly, but the adjacent margins of two whorls curve regularly to the deeply impressed suture; the last whorl,

measured upon the back, constitutes from a little more than one half, to about two thirds the whole length of the shell; surface coarsely wrinkled by the lines of growth, sometimes minutely reticulated by revolving lines, and sometimes exhibiting small, plane facets, irregularly disposed. Aperture generally less than, but never exceeding one half the length of the shell; sub-oval, rather contracted; right lip thin, with now and then a sub-marginal thickening, within colored reddish-brown; pillar margin copiously overlaid with white enamel, not closely appressed at the umbilical region; fold of the pillar large and oblique; umbilicus for the most part closed. Length $\frac{9}{10}$ inch, breadth $\frac{4}{10}$ inch, divergence 43 to 45°.

The *animal* is of a dusky-greenish color, similar to that of the shell, varying like it in intensity, minutely dotted with amber-color. Foot somewhat paler, tongue-shaped, reaching about two thirds the length of the large whorl when in motion, obtusely rounded behind.

The animal attains maturity and dies about the end of June. At this time the young may be seen with the old, about an eighth of an inch in length, and these continue to grow rapidly during the season. But after the early part of July it is rare to find an adult shell containing a living animal. At this time the exterior of the shell is much eroded; in fact the animals, as they cluster together, actually devour each other's shells; the aperture becomes white and somewhat chalky, and the brown, sub-marginal callus of the outer lip is thus covered over.

The most common species found in Massachusetts, and one which it is exceedingly difficult to describe, or to determine, if it has been already described. After much observation, and a comparison of many individuals collected from various localities, and an exchange of specimens with the most distinguished conchologists of this country, I have come to the conclusion, that it must be regarded as the L. *elodes* of Say. Its European analogue is L. *palustris.* The only Massachusetts shell which bears much affinity to it, is L. *desidiosa*, which is smaller, has a more slender spire, and larger aperture, proportionally. But it is closely related to L. *umbrosa* and L. *refléxa* of the Western and Middle States. The former is more solid, more corpulent, with the whorls and aperture more oblique, and its color darker than that of our shell. The latter has the whorls still more oblique, much less convex, forming a much less turretted and regularly tapering spire; the fold

of the pillar much less prominent, and the color yellowish. After all, these species are so nearly allied, that no description, and perhaps no figure will enable a person to determine any one of them by itself. They must be learned by comparison, and by interchanging specimens. But the difficulty does not end here. It is no easy matter to assign the limits of the species. No one presents a greater variety. The length of mature shells varies from half an inch to an inch ; and it is remarkable that the largest specimens are usually the most fragile. The surface usually has an uneven, unfinished, inelegant aspect, coated with mud ; but occasionally we find the conformation of the shell perfectly regular, the color a shining greenish horn-color, and the surface smooth and beautifully reticulated with longitudinal and revolving lines. It is then a very pretty, fragile shell. The aperture is small in proportion to the shell, generally rather contracted ; again, we find the lip beginning to expand, and in some specimens received from Vermont, which I suppose to belong to this species, the lip is broadly flaring. Young specimens might be confounded with L. *umbilicàta*, L. *desidiosa*, L. *modicéllus* and L. *caperata ;* but a little attention to the umbilicus, the aperture, the color, and the revolving lines will enable us to distinguish them respectively, The umbilicus is usually entirely obstructed by the overlaying callus ; but in some specimens it is partially open.

LIMNÆ'A CATASCOPIUM.—(Say.)

Shell ovate, strong, chestnut-brown ; whorls four, wrinkled, convex, the last large ; suture deep ; aperture sub-oval, half the length of the shell.

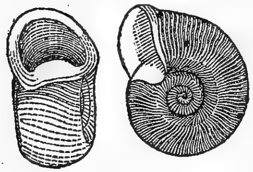
Shell rather large, oblong-ovate, ventricose, thick and strong ; epidermis chestnut or brownish horn-color ; whorls four or a little more, forming a short, pointed spire, delicately but rather regularly wrinkled by the lines of growth, and these are rendered somewhat corrugated by obsolete revolving lines ; last whorl constituting nearly the whole shell, very much distended ; suture deeply impressed ; spire very short, acute at apex ; aperture rather more than half the length of the shell, sub-oval, very little narrowed behind ; not dilated ; right lip simple, thick and regularly curved ; left lip having a thick, narrow layer of enamel, and a rather slight fold midway ; umbilicus not open. Length $\frac{7}{10}$ inch, breadth $\frac{4}{10}$ inch, divergence 60°.

Its great solidity, and its remarkably broad, corpulent aspect, approximating in character to PALUDI'NA, cause it to be easily recognised. Its analogue on the European continent is L. *péreger*, which, however, differs from this in being a less solid shell, in having the aperture somewhat expanded, its anterior curve broader, and the fold of the pillar less deep. It comes nearer to L. *emarginata* than to any other American species.

GENUS PLANORBIS, LAM.

Shell discoidal, whorls apparent above and below, aperture crescent-shaped, remote from the axis of the shell; operculum wanting; animal with thread-like tentacula.

PLANORBIS TRIVOLVIS.—(Say.)



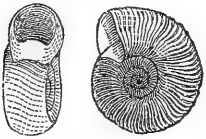
Shell orbicular, yellowish-white, brownish, or chestnut colour; umbilicated on the right side, cup-shaped on the left; on the right side scarcely three volutions, separated by a profound suture, are visible, as they disappear in the umbilicus, their faces, especially those of their interior whorls, being slightly carinated; on the left side at least four whorls are seen, which, by their faces, form a cup-shaped depression, scarcely distinguished by the suture, except the last half of the outer whorl, on the whole of which a well-marked carina revolves, forming a margin to the cup; the carina gives the whorl a flattened appearance on this side; surface covered with fine, regular, raised, transverse lines, somewhat grooved between them; aperture sub-ovate, inclining to the right, its right margin more advanced than the left, broadly and regularly rounded; left lip abruptly angulated where the carina terminates; lip usually thickened within, and of a reddish brown-colour. Large diameter $\frac{7}{10}$ inch, small diameter, $\frac{3}{10}$ inch.

Animal dark-russet or dusky, covered with pale-yellowish dots.

Planorbis corpuléntus of Say seems little else than an exuberant growth of this shell. The following differences may be noted. It is at least double, often three times, the size. It is a thinner shell. On the right side the volutions are less compact, and exhibit a larger portion of each whorl; on the left side the suture is more and the carina less distinct; the aperture is much more expanded, and projects far to each side of the preceding whorl.

Inhabits the vicinity of the Great Lakes. P. *trivolvis* differs from its next species by its carina, and the position of its aperture.

PLANORBIS LENTUS. (Say.)



Shell orbicular, each whorl encircling the preceding, greenish horn-colour at the circumference, yellowish at the sides, and bordering the aperture; on the right side concave, exhibiting scarcely three rounded volutions, separated by a well-defined suture, and disappearing in a deep umbilius; left side presents a shallow cup, formed of four compact slightly carinated whorls, distinguished by a tolerably distinct suture; surface marked with raised, subequidistant lines of growth; aperture large, ovate, inclining to the right; lip on the right side slightly curved, lying in the plane of that side of the shell; in front, regularly and broadly arched; on the left side, it stands out considerably beyond the preceding whorl, and undergoes a sudden curve before its junction with that whorl; the lip is sharp, very slightly spreading, and thickened within by dark reddish-brown callus. Greater diameter $\frac{7}{10}$ inch, smaller diameter $\frac{5}{20}$ inch.

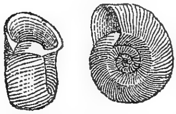
Animal dark olivaceous above and below; foot oval, about one half the diameter of the shell in length, minutely dotted beneath, and frosted above with amber dots; these are abundant about the bases of the tentacula; edges of mouth honey-yellow; motions sluggish.

Found abundantly in all our ponds, small brooks, and stagnant pools.

This is a somewhat darker shell than P. *trivolvis*, and is distinguished from it by its left side and its aperture. The cup of the left side is less smooth and regular, and is not bounded by the sharp, elevated line; when this shell is laid upon its right or upper side, the lip of that side will scarcely touch the plane on which it lies, while, in P. *trivolvis*, the shell would be lifted by the lip; the aperture has not the sharp angle of the left side, produced by the termination of the carina, but in the young stages it is difficult to distinguish the two. It is very closely allied to P. *corneus* of Europe; but in that shell the left side is scarcely concave, and the suture is deep; the aperture is nearly orbicular, being almost equally rounded on both sides.

This shell has hitherto generally borne the name of P. *trivolvis* in New England; but it is not the *trivolvis* of Say, and is either his P. *lentus* or a new species.

Planorbis Bicarinatus.—(Rackett.)



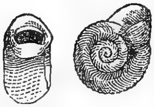
Shell orbicular, its tube rapidly increasing, deeply excavated on both sides, color brownish-yellow on the carina. Whorls rather more than three, as seen on both sides, forming on the right side a large and deep concavity, bounded by a sharp, raised line or carina, and on the left side a still deeper, inversely conic cavity, bounded by a similar carina, but of smaller circuit; surface rather smooth, with faint, irregular lines of growth, most distinct on the right side; aperture ovate, right side broadest, and on the general plane of that side of the shell; left margin strongly modified by the carina, and extending far beyond the plane of the preceding whorl; lip slightly expanded, white; interior brownish, with white lines in the grooves answering to the carina. Longest diameter $\frac{1}{2}$ inch, shortest diameter $\frac{3}{10}$ inch.

Animal light russet-color, beautifully dotted with amber; foot tongue-shaped, nearly as long as the diameter of the shell. The strong angle of the aperture fully displays the respiratory opening, which has a jagged flap, over which lies an acute groove; movements sluggish.

Inhabits still waters, not so generally pools, as the margins of large ponds. Not very common.

This species is smaller than either of the preceding, and is at once distinguished from them by the very obvious angularity of the whorls on both sides, and by the very deep, conical cavity of the left side. Sometimes a few faint revolving lines may be found on the surface. The tentacula of the animal are usually very long but sometimes one or both of them seem to have been broken.

Planorbis Campanulatus.—(Say.)

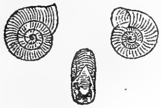


Shell discoidal, yellowish or brownish-green, lighter at the sides; diameter of its tube nearly twice as great from side to side as in the contrary direction; right side exhibiting scarcely more than two whorls, which are elevated to an obtuse ridge, and form an umbilical vortex very nearly perforating the shell; on the right

side are four volutions, distinctly separated by the suture, which are carinated, and form a shallow, salver-shaped depression; the whorls enclose each other in a very regular spiral to the last fifth of the outer one, when there is a sudden enlargement and distortion towards the left, by which a large, bell-shaped throat is formed; aperture also dilated, and strongly angular on the left side; within glazed, reflecting light-blue and brown; surface regularly marked with fine, transverse, raised lines, and intervening grooves. Greatest diameter $\frac{1}{2}$ inch, at right angles with this $\frac{2}{5}$ inch, small diameter $\frac{1}{5}$ inch.

This shell does not attain the size of the preceding species; and when mature, its dilated throat distinguishes it from every other known species; and the remarkable manner in which it is turned, as it were by violence, so as to look to the left, is a still further distinction. The outer whorl is everywhere of the same breadth; and the immature shell, before the dilatation of the throat, may be known by the very regular enrolment of the whorls, and the very contracted aperture in consequence of the very unequal diameters.

PLANORBIS ARMIGERUS.—(Say.)



Shell small, brownish horn-color, or light, chestnut, orbicular; right side nearly plane, with only a slight central pit, showing four rounded volutions, distinctly separated by the suture; left side deeply concave, exhibiting all the whorls, which on this side are sub-carinated; surface shining, faintly marked by the lines of growth, and on the left side, may be distinctly seen several raised revolving lines on each of the whorls; aperture slightly inclining to the left, rounded, and very slightly modified by the carina, very oblique; edge of lip dark-brown; at some distance within the throat are five white teeth, nearly closing the passage; a large, prominent, oblique one is situated on the side of the preceding whorl, and may always be seen; a very small one is by its side; opposite to them are the three others which are small. Larger diameter $\frac{5}{20}$ inch, smaller diameter $\frac{1}{10}$ inch.

Animal very active, of a blue-black or slate-color; foot long and narrow. The shell is carried inclined at an angle of 45°. The respiratory groove is very acutely pointed.

Found abundantly in shady, stagnant pools and ditches, in which an abundance of decaying vegetable matter is immersed.

This common shell is well marked by its external simplicity. At the same time, the complicated armature of the aperture, so unique in this family, would seem to entitle it to be arranged as a sub-genus. It differs from the preceding in having the umbilicus on the left instead of the right side, being its natural place. Mr. Haldeman proposes to make this species the type of a sub-genus, which he calls *Planorbula.*

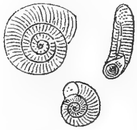
PLANORBIS HIRSUTUS.—(Gould.)

Shell small, somewhat transparent, of a brownish yellow-color; both sides concave, the left rather more than the right, but the concavity is there more limited by the presence of a sub-angular ridge on the outer whorl; whorls three, the outer one rapidly increasing; surface exhibiting traces of revolving lines when denuded, but usually covered with a dark pigment or epidermis, bristling with rigid hairs, which are arranged in close revolving lines; lines of growth very faint; aperture sub-oval, oblique, its diameter from side to side shorter than in the opposite direction; its plane very oblique. Long diameter $\frac{1}{5}$ inch, short diameter $\frac{1}{15}$ inch.

Animal has the head slate-colored above, with a darker line along each tentaculum, not originating from the eyes; foot chestnut-colored.

This *Planorbis*, though in many respects it resembles in shape P. *defléctus*, is readily distinguished from all other American species by the revolving hairy lines. It is the analogue of the European P. *albus*, from which it is difficult to designate any very characteristic difference. It is, however, a thinner shell, the last whorl increasing more rapidly; and it maintains its yellowish horn-color, whereas P. *albus*, assumes a spermacetti or still whiter appearance. The lines, too, disappear more entirely when the epidermis is gone.

PLANORBIS DEFLECTUS.—(Say.)



Shell small, distorted, compressed, of a light greenish-yellow color, something like dirty, bleached wax; right side in general convex, but with the centre slightly indented, suture distinct; left or under side concave, forming an expanded umbilicus, exhibiting about one half of each volution whorls four or five, very much compressed, and reduced to a

somewhat carinated perimeter; the last fourth of the outer whorl turns, somewhat suddenly and quite remarkably, to the left, or downwards; aperture large, ovate, lip commencing below the carina, and embracing but a very small portion of the preceding whorl; much narrower from side to side, its plane very oblique to the axis of the shell; lip simple, very slightly everted beneath; surface finely wrinkled by the lines of growth. Greater diameter $\frac{3}{10}$ inch, small diameter $\frac{1}{15}$ inch.

Animal dusky above, and with a still darker line to tip of tentacula.

Found in all our ponds, clinging to sticks, stones, &c.

It is distinguished at once, except in its very early stages, by the remarkable manner in which a portion of the last whorl is diverted from its regular course, downwards, if we consider the shell to be lying on its concave face. It is almost entirely turned off from the preceding whorls, so that the aperture comes in contact with only about half of its lower face. When immature it may be recognised by its light color and concave form. Scattered hairs may often be observed upon its surface. It has a general resemblance in its structure to P. *exacutus*, but the constantly sharp edge of that species is a never failing mark of distinction. I must at present regard the P. *virens* of Adams (*Bost. Journ. Nat. Hist.*, iii. pl. 3, f. 16.) as a variety of this species, in which the last whorl is not remarkably diverted from its regular course.

PLANORBIS EXACUTUS.—(Say.)

Shell lenticular, light transparent horn-color; whorls four, flattened so that the width of each is at least twice its depth, the upper and lower surfaces convex, and brought to a sharp exterior edge; the last half of the outer whorl deflected, so that the termination of the sharp edge is on a level with the lower surface of the preceding whorl; inner whorls slightly depressed, and somewhat more rounded; suture moderately impressed; striæ of growth faint; beneath abruptly umbilicated, displaying the edges of all the whorls within; aperture very oblique and angular; edge very sharp, below running forwards a little along the umbilical edge of the preceding whorl, then crossing obliquely forwards and upwards, leaving a callus, it passes off again a little below its carinated edge. Longest diameter $\frac{1}{5}$ inch, shorter diameter $\frac{3}{40}$ inch.

It is found in most brooks, ditches, and margins of ponds, which are permanent through the summer, adhering to sticks and stones.

This shell has a striking resemblance to the P. *fontana* of Europe, (Lightfoot, *Phil. Trans.*, lxxvi. pl. 2, f. 1–4. Montagu, *Test. Brit.*, 462, pl. 6, f. 6. Pl. *nitidus*, Mull., Turt., &c.,) except that the aperture is entirely below the sharp edge, instead of embracing nearly an equal portion on each side, as in that shell. It is allied to P. *deflectus*, Say; but in that the whorls are more numerous, the exterior edge much rounded, the umbilical region broader and more shallow, and the labrum also embraces bu half of the lower surface of the preceding whorl. Were it among the land shells it would be a most unequivocal Carocolla.

I cannot but think that the name under which this shell appears in the "Journal of the Academy," is not exactly as was intended by the author, as it is neither a Latin word nor a Latin termination. Supposing that by a typographical error, an *o* has taken the place of a *t*, we have a legitimate term, and one very expressive of the form of the shell.

Planorbis Parvus.—(Say.)

Shell very small and compressed, discoidal, light-yellowish horn-color; right side nearly plane, but excavated at the centre; left side broadly concave; whorls four, almost equally exhibited on both sides. the outer one usually somewhat angulated at its circumference; surface minutely marked by the lines of growth, shining, clear; aperture rounded, rather longer than broad, not inclining to either side, its plane very oblique; lip sharp, slightly reflected on the left side; within bluish-white. Greatest diameter $\frac{1}{4}$ inch, lesser diameter $\frac{1}{15}$ inch, but generally much smaller.

Animal whitish, dusky above, with a still darker line at tip of tentacula.

Abundant in brooks and ponds.

This is the smallest shell of the genus which we have, unless, perhaps, it be P. *exacutus*, which is commonly found of as small a size. It is not difficult to be recognised by its regular figure, and its very thin, compressed appearance. P. *déflectus*, *armigerus*, *exacutus*, and *hirsutus*, all have marked peculiarities, which at once separate them from this undistinguished species.

Planorbis Dilatatus.

Shell small, of a yellowish green-color, minutely wrinkled by the lines of growth; spire flat, composed of not more than three whorls, separated by a well-defined suture; the outer whorl has a sharp margin on a level with the spire, diminishing near, but still modifying, the aperture; below this line the whorl is very convexly rounded so as to encircle a small, deep, abruptly formed umbilicus. This whorl rapidly enlarges, and terminates in a very large, not very oblique aperture, with the lip expanded so as to make it trumpet-shaped. Largest diameter $\frac{3}{20}$ inch, breadth $\frac{1}{20}$ inch.

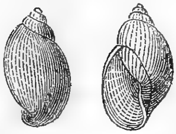
It has a miniature resemblance to P. *bicarinatus* as to its two sides, but it has only a single carina, which encircles the shell, instead of one on each side. Its large, expanded aperture, and small, deeply sunken umbilicus, readily distinguish it from any of the small species hitherto known. The surface is rather rough, and perhaps a little hispid when viewed under the microscope.

The P. *lens* of Lea (*Amer. Philos. Trans., New Series*, vi, 68, pl. 23, f. 83,) which he received from near Cincinnati, is probably the same as this shell. His name, however, is pre-occupied by a fossil species.

Genus PHYSA, Drap.

Shell reversed, oblong-ovate, spire prominent; aperture rounded before, narrowed and angular behind, lip sharp; inner lip twisted Animal has thread-like tentacula, and the sharply lobed mantle. is turned back upon the shell.

Physa Heterostropha.—(Say.)



"Shell sinistral, sub-ovate; color pale-yellow, chestnut, or blackish; whorls four, the first large, the others very small, terminating rather abruptly in an acute apex; aperture large, somewhat oval, three fourths the length of the shell, or rather more; within of a pearly lustre, often blackish; lip a little thickened on the inside, and tinged with dull red." (Say, *in Nich. Encyc.*) Ordinary length about $\frac{1}{2}$ inch, breadth $\frac{1}{4}$ inch, divergence 68°. My largest specimen is $\frac{7}{10}$ inch by $\frac{2}{5}$ inch.

When the shell is fresh and perfectly clean, it is always of a light greenish-yellow, and becomes a little more dusky with age.

The surface, under the magnifier, appears beautifully checkered with minute, revolving, and longitudinal lines, which are also a little waved. Sometimes there are one or more whitish, opaque bands, as if scratched by the mantle of the animal. The thickening of the lip is found only in old specimens, and in these also there is a broad layer of pearly enamel reflected over the columella, which has also a very prominent fold.

The *animal* is olivaceous, surface very smooth and silky; the foot is kite-shaped, longer than the shell, terminating in an acute point; expansions each side of the mouth acutely angled; tentacula olivaceous above, light ferruginous beneath, long and threadlike. The pointed lobes of the mantle are very conspicuous.

The motions of the animal are very rapid, and it seems to move with equal facility in an inverted posture, at the surface of the water.

The ova are excluded, enveloped in a gelatinous substance, about twelve or fifteen in number, and of an egg-shaped form. In about a fortnight they escape from the jelly, and move about with great rapidity. In fact, they are seen in motion for some time previous, apparently struggling to disengage themselves from their nidus.

This shell is everywhere to be found. Scarcely a brook or pool is met with but some of these shells will be found in it. It is more especially to be found in the running brooks.

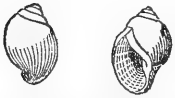
The difference between this and P. *fontinàlis* of Europe, is very slight. The spire may be a little more prolonged and acute.

It is interesting to keep a number of them in a vessel of water, and observe their motions and habits. The manner in which they open their mouths and display the lingual organ,—the manner in which they rise to the surface and open the air cavity, into which its structure permits no water to enter,—and above all, the beautiful and unaccountable manner in which it glides along, will never fail to excite astonishment. They feed freely upon any kind of vegetable.

We have here an instance of the intermirable chain of existences, and of the subserviency of one animal to another. And it is curious, too, that, in general, we have the power to elude or subdue animals of greater strength and magnitude than ourselves, much better than we can those which are inferior to us. On looking carefully about the neck of the animal of this shell, we find him beset with numerous little things looking like short,

minute, white lines, which are, in truth little parasites (*Górdius inquilinus*, Müll.) attached like leeches, and which derive their nourishment from the fluids of the animal, without his having the power to dislodge them.

PHYSA ANCILLARIA.—(Say.)



" Shell heterostrophe, sub-globose, pale-yellowish; whorls rather more than four, very rapidly attenuated; spire trunc: ted, hardly elevated beyond the general curve of the surface; suture not impressed; aperture but little shorter than the shell, dilated; labium a little thickened on the inner sub-margin." (SAY.) Length $\frac{11}{20}$ inch, breadth $\frac{7}{20}$ inch, divergence 90°.

Found in Connecticut and Merrimack Rivers, Fresh Pond, &c.

Animal of a bright lemon-color.

This shell is distinguished from the preceding by its much shorter spire, more angular outline, and especially by its suture, the margin of one whorl being so closely and perfectly applied to the preceding as to give the appearance of a double suture. The surface is exceedingly smooth, no revolving lines being detected by the magnifier. The base of the aperture is somewhat narrowed and prolonged downwards, and considerably effuse. The twisted fold of the columella is less conspicuous than in P. *heteróstropha*. The shell becomes more ponderous and yellowish by age; and the reddish rib along the outer lip, and the enamel on the columella, much thicker.

PHYSA ELONGATA.—(Say.)

" Shell heterestrophe, pale-yellowish, very fragile, diaphanous, oblong; whorls six or seven; spire tapering, acute at tip; suture slightly impressed; aperture not dilated, attenuated above, about half as long as the shell; columella much narrowed near the base, so that the view may be partially extended from the base towards the apex." (SAY.) Length $\frac{1}{2}$ inch, breadth $\frac{1}{5}$ inch, divergeuce 34°.

Animal dusky, the head above of an orange hue; tentacula rather short and blunt, lighter at tip; respiratory groove long, narrow and thin, movable in various directions, almost as long as a tentacle, with two black spats like eyes near its tip.

This species is easily recognised by its slender, elongated form, and the great proportionate length of the spire. It is in every

respect similar to P. *hypnórum* of Europe, unless perhaps, its spire may be somewhat more produced.

It is not very common in Massachusetts, and is seldom found as long as the above dimensions; while Mr. Say gives it $\frac{7}{10}$ of an inch in Illinois.

It probably belongs to the genus Aplexus of Gray (*Turton's Man.*, 255), which he institutes upon the elongated form of the shell, the want of auricles at the base of the mantle. This latter point I did not notice, when the animal was before me.

Mr. Say describes the animal as black, and spotless above and below; tentacula with a white ring at base. He must have observed them at a more advanced age than any I have seen living; or else the species observed are different.

Genus ANCYLUS, Muller.

Shell boat-shaped, without a spire, apex pointed, inclining forwards and to one side; aperture ovate.

It is not yet satisfactorily determined under what family this genus should be arranged. Its animal is closely allied to the Limneana, and its natural relations are certainly stronger to this family, notwithstanding the form of the shell, than to the Calyptra'cea, where it has usually been placed.

A'ncylus Rivularis.—(Say.)

Shell small, narrow, elongated-oval, the sides nearly parallel, but one end is somewhat narrower than the other, and both are regularly rounded; apex nearly equi-distant from both extremities, nearer to, and leaning to, one side and one end; aperture oval; color dark-green. Length $\frac{1}{5}$ inch, breadth $\frac{1}{10}$ inch.

Found on stones and floating leaves in rivulets and ponds.

It is closely allied to A. *fluviatilis* of Europe; but the apex is less acute and more central. There is another American species, the A. *tardus*, Say, which has been found by Professor Adams in Vermont, but which I have not yet found in this State. It is much more rounded and conical than this, and the apex is not lateral.

A'ncylus Fuscus.—(Adams.)

Shell small, very thin and pellucid, of a round oval form, the entire outline regularly curved; depressed and regularly convex, not compressed at the sides;

apex slightly elevated, bluntly rounded a little behind, and to the right of the centre; stages of growth visible; epidermis coarse and strong, rough, dusky yellowish-brown, extending beyond the margin of the testaceous matter, and insensibly coalescing with it on all sides, which are inclined to turn upwards; within glistening, polished. Length $\frac{3}{10}$ inch, height $\frac{1}{20}$ inch, breadth $\frac{22}{100}$ inch.

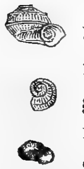
Found in a rivulet in Andover by Mr. K. Prescott, of the Theological Seminary; and also found by Professor Adams in Mansfield; and by myself, in Fresh Pond.

It differs from all other described species in its depressed form its obtuse apex, and its coarse epidermis projecting beyond the margin; and, as this extends in the direction of the plane of the object to which it is found attached, and not in continuation of the convex form of the shell, the edges seem to be turned upwards. A. *rivularis*, Say, is narrower, and has the sides nearly parallel. A. *tardus*, Say, has its apex prominent, acute, and farther behind the middle.

Genus VALVATA. Muller.

Shell conical, whorls cylindrical, loosely cohering; aperture circular, its margin entire; operculum orbicular.

Valva'ta Tricarinata.—(Say.)



Shell small, depressed, thin, transparent and shining, of an emerald or light pea-green color; whorls three or four, flattened at the summit, faintly marked by lines of growth, and separated by a distinct suture; each of the interior whorls has one or two prominently raised, rounded, revolving lines or keels, and the exterior one has three, one of which issues from the lower junction of the lip and borders the umbilicus; a second originates from the upper junction of the lip, and circumscribes the whorl; the third midway between this and the suture, thus giving the whorls a prismatic or quadrangular instead of a cylindrical appearance; aperture circular, modified by the keels; lip simple, surrounding the aperture, except a small space between the two lower keels; umbilicus broad, deep, tunnel-shaped. Height $\frac{1}{10}$ inch, breadth $\frac{7}{40}$ inch.

It is found in most of our small lakes, usually under stones, or sheltered by the deserted shells of some of the fresh-water mussels.

The shell is usually rendered somewhat opaque by an earthy coating, which seems to answer the purpose of an epidermis; but,

when this is removed, the surface is shining and pearly, of an emerald-green color, lighter on the keels. It is one of our most curious shells.

VALVATA PUPOIDEA.—(Gould.)

Shell small, elongated-ovate, opaque, chestnut-colored, when divested of the rough, dirty pigment which usually adheres closely to it; whorls four or five, minutely wrinkled, the posterior one small and flattened so as to form an obtuse apex; the others cylindrical, and so partially in contact as to expose about one half of the cylinder; the last entirely disjoined from the preceding one for at least the half of a revolution; aperture circular, lip simple and sharp; on looking at the shell from below, no umbilical opening is found; operculum horny, apex central, elements concentric. Length $\frac{1}{10}$ inch, breadth $\frac{3}{40}$ inch.

Found at Fresh Pond and other ponds, on stones and submerged sticks; and has been for many years in our cabinets marked as a PALUDI'NA.

Animal very active; head proboscidiform, half as long as the tentacles, bi-lobed in front, dark, terminated with light; tentacles rather stout, light drab-colored, with a line of silvery dots on the upper side, over the large, black eyes; foot, tongue-shaped, as long as the first whorl, dilated into two acute angles in front, light drab-color; respiratory organ occasionally protruded to half the length of a tentacle on the right side.

This species is widely distinguished from all other described ones by its minuteness, its elongated form, and its want of an umbilicus; of which characters the last two seem to arise from the loose manner in which the whorls are united.

AMNI'COLA PORATA.—(Say.)

Shell minute, conic-globose, thin, translucent, smooth, or with most delicate lines of growth; varying from a bronze-green to a light olive-green color, but usually invested with mud; whorls four or less, very convex, and flattened near the suture, so as to present a conspicuous shoulder; the last whorl rather more than two thirds the length of the shell, and as broad as long; suture deeply impressed, almost channelled; aperture nearly circular, both lips being about equally curved, and uniting posteriorly at a broad angle; lips sharp, in some instances a little everted; inner lip, at maturity, barely

touching the preceding whorl just before it joins the outer lip, leaving a very large, deep umbilicus. Length $\frac{3}{20}$ inch, breadth $\frac{5}{10}$ inch, divergence 68°.

Found in ditches and brooks, clinging to stones or submerged plants, oftentimes iu great numbers.

Animal a light drab color tinted pink, the head a little flesh-colored above; tentacula silvery, with a dark line running along the outside from the eyes, which are at the external base; foot not reaching beyond the first whorl, broadly rounded behind, dilated into angles at each side in front; head half the width of the foot, and projecting beyond it, motions very slow. In delicate and clean specimens, a dark mark parallel to the outer lip, and another bisecting it, and belonging to the animal, appear through the shell.

Under this species I include all the small shells, hitherto regarded as PALUDI'NÆ, which are collected in this region, ascribing the very great differences they present in color and size to differences of locality and age. The shoulder of the whorls, the conspicuous umbilicus, and the rounded aperture, almost like VABVA'TA or CYCLOSTOMA, are the most obvious characters. It is less solid, less elongated, the aperture more circular, and the inner lip much less closely appressed to the preceding whorl than P. *limosa* Says P. *lustrica*, Say, is described as much smaller, much more elongated, and more cylindrical. This I strongly suspect to be identical with *valvata pupoidea* in an immature state. It approaches nearest to P. *Cincinnatiénsis*, Anthony, which is larger and more conical and elongated.

ARTICLE XXIII.—*On the Order Lepidoptera, with the description of two species of Canadian Butterflies.*

On reference to the classification of the Animal Kingdom, published in the first number of this magazine, Feb. 1856, p. 26-31, it will be seen that the second Department or Division *Articulata* is divided into three classes: *Insecta*, *Crustacea*, and *Annelides* (or worms). The first of these three classes is further divided into three sub-classes, viz.: *Manducata* (or Mandibulata,) insects with jaws; *Suctoria* (or Haustellata,) insects with a sucker; and *Aptera*, or wingless insects. The second of these sub-classes con-

tains several orders, viz.: *Lepidoptera*, or Butterflies and Moths; *Diptera*, or two-winged flies; and *Hemiptera*, bugs, boat-flies, &c. The present article deals with the first of these orders. In future numbers we shall probably give a sketch, not only of the remaining orders of Suctoria, but also of Mandibulata and Aptera.

INSECTA HAUSTELLATA.—ORDER LEPIDOPTERA.

Butterflies and Moths are distinguished from all other insects, *by having the wings clothed with scales.* The scientific term "Lepidoptera" is derived from two Greek words, *lepis*, a scale, and *pteron*, a wing. Their wings are not transparent like those of a bee, a fly, or a dragon-fly, nor are they horny like the elytra of a beetle, but both surfaces are thickly covered with small scales, which are easily removed, and laid one over the other with great regularity like tiles on the roof of a house. If these be rubbed off, the membrane of the wing is left entirely colourless. It is to these scales, therefore, that they owe the splendid colours which render them the objects of such universal admiration. The order is divided into two great Sections: 1. Rhopalocera, containing the *Butterflies*, and of which we shall presently treat; and 2. Heterocera, which includes the Hawkmoths, Bombyces, Noctuæ, Geometræ, &c.; or, in short, all the Lepidoptera not having a knob to the antennæ. They all alike pass through the stages of egg, larva, pupa, and imago; and the larva, or Caterpillar, changes its skin several times before it becomes full fed, when it changes to the Pupa, without legs and motionless, frequently forming for its protection in that state, a cocoon of silk, which, in some species, has been an article of commerce from the earliest ages. Want of space compels us to conclude this brief and imperfect sketch of this interesting order, which is supposed to contain more species than any other except *Coleoptera*; and we now proceed to the consideration of the

SECTION I.—RHOPALOCERA, *Boisduval.*

LEPIDOPTERA DIURNA, *Latrielle.* (BUTTERFLIES.)

The Diurnal Lepidoptera, or Butterflies, corresponding with the Linnean genus Papilio, are distinguished from all other Lepidoptera, by having the antennæ long and slender, and terminated by a knob, or club.* In the Hesperidæ this club is hooked at the

* Certain foreign genera, however, such as *Morpho* and *Urania*, form an exception to this rule, as they have antennæ either of equal thickness throughout or tapering slightly at the summit.

tip. They are also destitute of the bristle at the base of the anterior edge of the second pair of wings, which in the moths passes through a loop in the under side of the fore wings, retaining them in their proper position during flight. The wings when at rest are, with a few exceptions, carried erect over the back, their upper surfaces being brought into contact. Their flight is invariably diurnal, and they are always furnished with a proboscis or t ngue. The under side of the wings is generally equally ornamented with the upper, and frequently exhibits a different pattern. Their Caterpillars are constantly furnished with 16 feet (6 thoracic, 8 ventral, and 2 anal.) They are frequently smooth, but are generally armed with sharp branched spines and other appendages. Their chrysalides are almost always naked, attached by the tail and often by a girth of silk round the middle of the body. They are often angular in their form, scarcely ever enclosed in a cocoon, and a few are subterranean. They are variously and sometimes handsomely coloured, and many present those metallic hues from which the terms "Chrysalis" (*chrusos* gold,) and "Aurelia" (*aureus*, golden) take their orgin. The word "Butterfly" is a literal translation of the Saxon word, *Buttor-fleoze*, and is supposed to be applied because the insects first became prevalent at the beginning of the season for butter. Butterflies are the most generally and familiarly known of all the insect tribes; and by their conspicuous appearance, and splendid colours, seldom fail to attract the notice even of those whose perceptions are least alive to the beauty of natural objects. The species are very numerous; between 2000 and 3000 have been described, and it is probable a very considerable number remain undiscovered. In the larva state they feed on a great variety of plants, from the towering oak of the forest to the humble cabbage of our gardens; but, in their perfect form, they derive their sustenance entirely from the nectareous juices of flowers and fruits. It is worthy of remark, that most of the principal groups are characterized by the prevalence of particular hues; thus, the greater portion of the genus *Pieris* is white; *Colias*, various shades of yellow; *Argynnis*, almost invariably fulvous or reddish brown; the *Lycæna*, are mostly fulgid copper colour; and the *Polyommati*, are either blue or brown.

The Diurnal Lepidoptera are divisible into the six following families, all of which are represented in North America:—

1. Papilionidæ,
2. Heliconidæ,
3. Nymphalidæ,
4. Erycinidæ,
5. Lycænidæ,
6. Hesperidæ.

The last family differs from all the others in the habit of the caterpillars rolling up leaves, within which they undergo their transformations.

FAMILY I.—PAPILIONIDÆ. LEACH.

This family consists of some of the most gigantic species of Butterflies, distinguished by the perfectly ambulatory structure of all the six legs, the anterior pair not being more or less rudimental; the hind tibiæ have only a single pair of spurs at the tip; the tarsal ungues or claws are distinct and exposed, single or bifid; the antennæ are never hooked at the tip, the club being distinct, but variable in form; the palpi are variable, but the third joint is never suddenly slenderer than the rest and naked; the discoidal or central cell of the hind wings is always closed behind by a nervure; the abdomen is short, slender, and often laterally compre sed; the proboscis short, or moderately long. The Caterpillars are elongated, nearly cylindrical, but are frequently thickened or shortened, and are either smooth or pubescent, rarely spinous; the Chrysalides are attached, not only by the ordinary anal hooks, but also by a girth round the middle of the body. In one genus (Parnassius) it is, however, inclosed in a rough cocoon. Almost all the Butterflies of this family are powerful fliers, and it frequently requires a good chase to capture specimens of some of the species.

This numerous family is divided into two very distinct sub-families—Papilionidi and Pieridi—both of which are well represented in this country.

SUB-FAMILY I.—PAPILIONIDI. STEPHENS.

Anal edge of the hind wings concave, or cut out to receive the abdomen; the anterior tibiæ have a spur in the middle; the tarsal ungues or claws are simple; they are furnished with very powerful muscles at the base of the wings, which are very large and their flight rapid. The Caterpillars are slow, cylindrical, thickened, and never villose or hairy, but a few are armed with spines. They are always furnished with two fleshy retractile tentacles in the form of a Y, issuing from a common tubercle, upon the back of the segment succeeding the head, which the insect throws out when alarmed, emitting at the same time an acrid liquid with a disagreeable odour. This curious organ is supposed to be intended as a weapon of defence against Ichneumons and other parasites, to the attacks of which they are very subject.

From the beauty of their colours, the insects of this sub-family were styled by Linnæus, in his fanciful arrangement of the Butterflies, Equites or Knights, and were divided into two sections; those with black wings, and spotted with red on the breast, forming the first group, Equites Troes or Trojan Knights; and those which are destitute of these markings, but are ornamented with an ocelated spot on the anal angle of the hind wings, constituted the second, Equites Achivi or Greek Knights. In modern arrangements it is formed of several genera, of which only the typical one, Papilio, occurs in North America.

GENUS I.—PAPILIO. LINNÆUS.

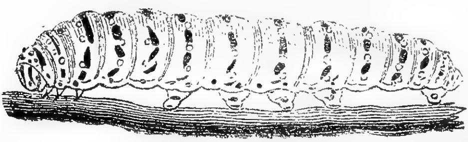
Antennæ rather long, with a moderately large oval and gradually formed club, which is somewhat curved and not compressed; Palpi very short, not projecting beyond the head, all the joints very indistinct, and the third or terminal one very minute and hardly visible; tongue long; eyes large and naked; abdomen rather short and ovate conical; wings strong and elongate, more or less toothed at the edges, the posterior pair being often produced into a long point or tail, from whence they have obtained the name of "Swallow-tailed Butterflies," and having the inner margin folded upwards so as to allow of the free motion of the abdomen; the strong central nerve of the fore wings emits four branches behind, and the middle cell of the hind wings is closed and emits six nerves. The first pair of legs are alike in both sexes—the two fore legs being fitted, as well as the four hind ones, for walking; the anterior tibiæ have a single strong spur at the middle, the four posterior tibiæ have two long spurs at the tip of each. The anal valves of the male, of moderate size. Larvæ naked, never pubescent, and furnished on the neck with a fleshy furcate tentacle, which they are able to retract or exsert at will. In a very large number the two first segments are attenuated and capable of being drawn in under the third and fourth, which are swollen, and often ornamented with ocular spots. The Chrysalides are attached by the tail, and girt round the middle by a silken thread, with the head pointing upwards, and forked or bimucronate.

This genus is extremely numerous—Boisduval having described 224 species, exclusive of several which he has detached under other generic names. They are mostly of large size, and are found in almost every quarter of the globe. They are more nu-

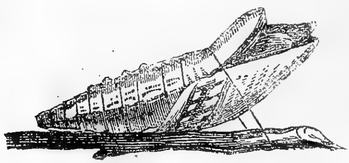
merous in the new world than in the old, but the difference is by no means considerable. In the former, Brazil alone produces between forty and fifty species; and in the latter, the greatest number occur in the islands of the Indian Archipelago, which is also the natural country of the magnificent Ornithoptera, (another genus of the Papilionidæ.) The continental parts of India, China, Java, &c., likewise possess many fine species, and a few are found in New Holland. Europe is exceedingly poor in insects of this group—only three or four species being indigenous, of which but one is found in England. Boisduval describes twelve species as inhabiting North America. They all have the hinder wings tailed, excepting P. Polydamas. Only two species, we believe, occur in the Canadas, viz., *P. Asterias* and *P. Turnus.* We are not aware that *P. Troilus, Glaucus, Calchas,* or *Philenor* inhabit any of these Provinces, though it is not unlikely that the first at least occurs in some of the more southern portions, as it is included in lists of insects inhabiting Massachusetts. Our two species are very readily distinguished from each other, not only in the Imago, but also in the Larva, as they are of a different shape, as well as ornamented in a very different manner.

SPECIES I.—PAPILIO ASTERIAS. BLACK SWALLOW-TAILED BUTTERFLY.

Plate iii., fig. 2, male; fig. 3, female.



a

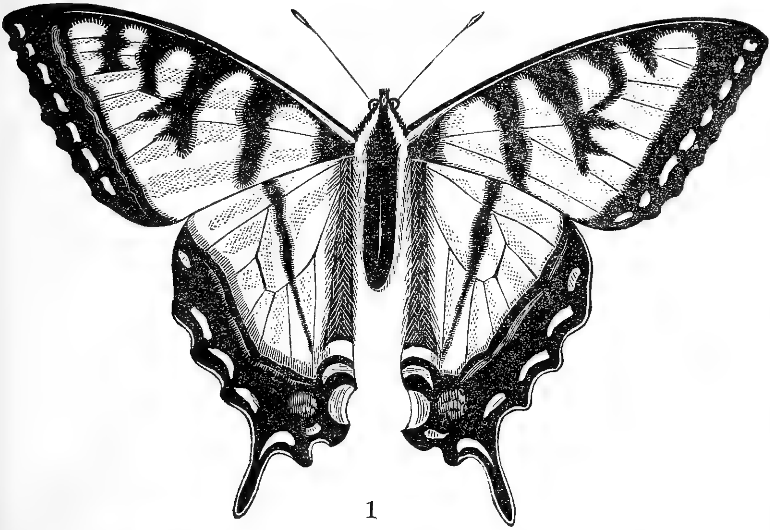


b

a. The Caterpillar. b. The Chrysalis.

Clerc : Icones, t. xxxiii, fig. 3, 4; Holmiæ, 1757-1762.
P. Asterias, Fabricius, Entom. Syst. Em., t. iii., pars 1, p. 6, n.

PLATE III.



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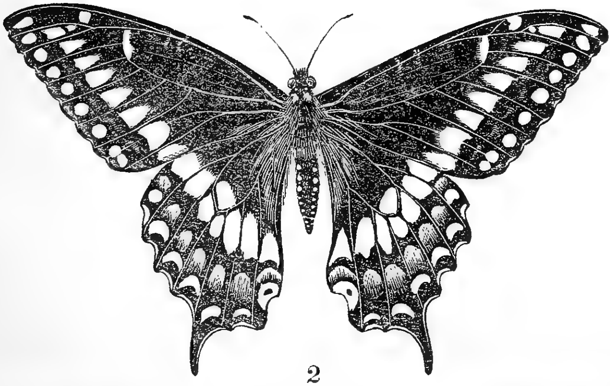

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3

1. Papilio Turnus. 2. Papilio Asterias, male. 3. ———, female.

16, Holmiæ, 1792-1794; Mant. Insect. t. ii., p. 2, n. 13, Hafniæ, 1787.

P. Asterias, Godart, Encyclop. Ins. t. ix., pars. 1, p. 58, n. 91, Paris, 1819 1821.

P. Asterias, Boisduval and Leconte, Ico., &c., des Lepidopterès, &c., de l'Amerique Sept. t. 1, p. 14, pl. 4, fig. 1-4, Paris, 1833.

P. Asterias, Turton's Linné, p. 8, vol. iii., London, 1806.

P. Asterias, Emmon's Agri. New York. Insects, p. 200, Albany, 1854.

P. Asterius, Cramer, Pap. xxxiii., p. 194, pl. ccclxxxv., fig. c. d., Utrecht, 1782.

P. Troilus, Smith and Abbot, the Nat. Hist. of the rarer Lepid. Ins. of Georgia, vol. i., p. 1, tab. i., London, 1798.

Drury Insect 1, tab. ii., fig. 2. London, 1770-1775,

Male.—Wings denticulated, black, with two spotted bands of a pale yellow; the first, placed a little beyond the middle of the anterior wings, is composed on the latter of eight more or less triangular spots; it then traverses the middle of the posterior wings, where it is only interrupted by the nervures, which are very strong and distinct; the second, entirely marginal, is composed of spots more interrupted and smaller than in the preceding; upon the fore wings it is formed of eight or nine spots, and on the hind wings, by six, mostly lunules. Besides the two bands already mentioned, there are two large yellowish dots before the first band on the anterior wings; and upon the posterior wings, between the yellow bands, six or seven blue lunules, of which the upper ones are less determined; and lastly, at the anal angle a rufous spot, marked in the middle by a black dot. The notches of the wings are bordered with yellowish, and the tails are black and rather short.

The under side of the fore wings is paler than the upper, but presents precisely the same markings; the first band, however, is of a pale fulvous instead of being yellow, with the exception of the two or three first triangular spots, which are frequently of the same tint as on the upper side. The under side of the hind wings is much like the upper, as to the design, but the two bands are of a reddish orange, with the exception of the two last spots, which are yellowish like the upper side. The body is black, with three series of yellow spots on the sides; two small dots on the

hind head, and two on the front of the thorax. Antennæ black, and rather long. Expansion of the wings about 3 inches.

Female.—Very similar to the male, but differs in having the first band formed of smaller dots, and sometimes they are almost obsolete on the inferior wings, whilst the blue lunules are larger and more distinct. Expansion of the wings, about 4½ inches; but, in many specimens, there is little difference of any kind between the two sexes.

The Caterpillar very much resembles that of the English P. Machaon. It is of an apple green, with a transverse band upon each segment, formed by alternate black and yellow spots, except upon the three first, where the black band is only interrupted by the yellow points towards the stigmata. Whilst upon the back they are in front of the black band, and not in a line with it. Besides this, there are three black dots upon the anterior part of the first segment, and two lines of the same colour upon the head. The feet have the crown or suckers black, with a spot of the same colour at the base. Like all the other larvæ of this genus, it is furnished with an orange-coloured forked organ on the top of the segment behind the head. The figure in Boisduval's work on the North American Butterflies is not well coloured, and does not give a good idea of it. This Larva lives on the carrot (*Daucus carota*,) upon fennel (*anethum feniculum*,) and upon many other of the Umbelliferæ. About Montreal we have frequently met with it in gardens, on Parsley, and on a plant called "Everlasting Celery." Emmons mentions it as being found in the month of June, whilst we have observed it at the beginning of September; but there are two broods in the year, the autumnal one passing the winter as pupæ and producing those specimens of the Butterfly which we first see in Spring.

The Chrysalis is at first pale green, but soon changes to brownish white, with darker markings. The summer brood or broods (for Boisduval says there are three during the season) pass only about a fortnight in the pupa state. This species is so very subject to the attacks of Parasites that out of seven pupæ which we kept one winter, not one produced the butterfly, but from each came out a large Ichneumon, with red body and legs, and steel blue wings, which made its escape by gnawing a large round hole in the side of the pupa. When the chrysalides are kept in a warm room through the winter, this parasite will often make its appearance as early as January or February.

[illegible] the [illegible] while the blue lunules are larger and more distinct. Expansion of the wings, about 4½ inches; [illegible] specimens, there is little difference of any kind between the two sexes.

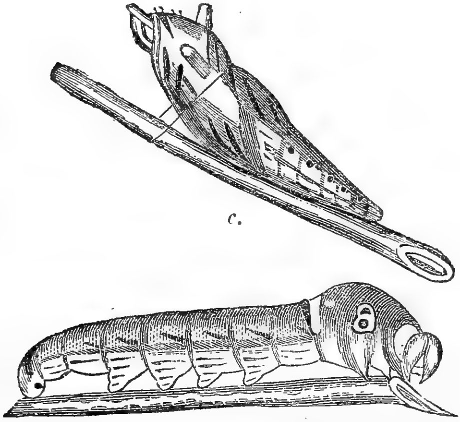
The Caterpillar [illegible] resembles that of the English *P. Machaon*, [illegible] green, with a transverse band upon each [illegible] alternate black and yellow spots, except [illegible] where the black band is only interrupted by [illegible] the segments. Whilst upon the back [illegible] the black band, and [illegible] line [illegible] black dots upon the [illegible] the first segment and [illegible] orange colour upon the [illegible]. The [illegible] are black, [illegible] at the base [illegible] of the [illegible], it is [illegible] orange-coloured forked organ on the top of the segment behind the head. The figure in [illegible] work on the [illegible] Butterflies is not well coloured, and does not give a good idea of it. This larva lives on the carrot (*Daucus carota*), fennel (*[illegible]*) and upon many other [illegible] plants. [illegible] we have frequently met with it [illegible] on a plant called the [illegible] [illegible] in the month of [illegible] the beginning of [illegible] [illegible] passing the winter as pupæ and producing those specimens of the Butterfly which we first see in spring.

The Chrysalis is at first pale green, [illegible] changes to [illegible] white, with darker markings. [illegible] [illegible] that there are three [illegible] about a fortnight in the pupa state. [illegible] to the attacks of Parasitic [illegible]

The Butterfly frequents gardens, the vicinity of habitations, and every place where the umbelliferæ grow. It is common in Newfoundland, Virginia and Georgia, and is also found in the West Indies, and even in South America. It is however remarkable, that, although so numerous about Montreal, we have never observed it either at Sorel or Quebec, and Mr. Gosse did not meet with it in the Eastern Townships. It is said to be somewhat irregular in its appearance, being more abundant in some years than in others. It is not so strong a flier as *P. Turnus*, and is much more easily captured.

Species II.—PAPILIO TURNUS.—Tiger Swallow-tailed Butterfly.

Plate iii, fig. 1.



d

c. The Chrysalis. d. The Caterpillar.

P. Turnus, Linné, Mant., p. 536, Holmiæ, 1771.

P. Turnus, Fabricius, Syst. Entom., p.452, n. 41, Flensburgi, 1775.
Spec. Inc. t. ii, p. 16, n. 66. Hamburgi, 1781.
Mant. Ins., t. ii, p. 9, n. 76. Hafniœ, 1787.
Entom. Syst. Em., t. iii, pars. 1, p. 29, n. 86. Hafniæ, 1792-1794.
Herbst, Pap., t. xli., fig. 3, 4. Berlin, 1785-1806.

P. Turnus, Godart, Encyclop. method. Ins., t. ix., pars. 1, p. 56, n. 87, Paris, 1819-1821.

P. Turnus, Palisot de Beauvois, Ins. recueillis en Afrique et en Amer., vii. livrais, pl. ii.

P. Turnus, Hubner, Exot. Ausburg, 1806, &c.
P. Turnus, Boisduval, t. 1, p. 20, pl. 6, 7, fig. 1, 3. Paris, 1833.
Emmons, Agri, New York, p. 201, pl. xxxviii., fig. 3. Albany, 1854.
P. Alcidamas, Cramer, Pap., p. 62, pl. xxxviii., fig. A, B. Utrecht, 1782-1791.

This Butterfly is one of the largest of all those which are found in the New World. It is shaped like the English P. Machaon, but is very differently marked. All the four wings are pale yellow, with a rather broad black border. The anterior wings have the base, costal edge, and the nervures black. They have also four black transverse stripes: the first extending all across the wings from the costa to the inner margin; the other three are abbreviated. The border of these wings contains nine yellow spots The posterior wings have an oblique linear band across the middle, from the costa to the anal angle, and joining the first stripe of the upper wings, and the nervure which closes the central cell is strongly marked with black; the inner margin is also black. The centre of the black marginal band is considerably powdered and tinged with blue, and contains six lunules, of which the first and last are fulvous, and the rest yellow. The anal angle is ornamented with four lunules respectively—yellow, black, blue and fulvous. The fore wings are slightly, and the hind wings very strongly, dentated; the notches of all are edged with yellow. The "tail" is moderately long, swollen at the tip and black, bordered on the inner side with yellow. The markings on the under side of all the wings are nearly the same as on the upper, but the colours are paler and more diffused; the black being considerably powdered with yellow scales, giving it a greenish tint; the yellow spots of the marginal band of the anterior wings are run into each other, forming a narrow stripe, bordered on each side by a blackish band. The lunules of the posterior wings are fulvous and the blue is more determined, and forms a narrow band separated from the fulvous lunules by a band of greyish black. The head, antennæ and legs, are black; palpi, yellow; thorax and abdomen black, longitudinally striped with yellow. Expansion of the wings, between 4 and 5 inches.

The Caterpillar is a fine velvety green on the back, whitish underneath, and the sides are whitish green, with seven green stripes placed obliquely. Between the fourth and fifth segments on the back, there is a transverse band, yellow in front and black be-

hind; the third segment is ornamented on each side with a yellow eye-like spot, containing two blue pupils; the head is flesh-coloured, with the collar yellow. It feeds on a great many plants of the genus *Prunus*, principally on *Prunus Virginianus*, and *Prunus Serotina* (Choke-cherry.) Abbot frequently met with it on *Ptelea Trifoliata;* and Mr. Gosse in that charming work, the "Canadian Naturalist," mentions that he has taken it from willow, poplar, and bass-wood (*Tilia* ... *bra*,) but chiefly from brown ash; and that the young larvæ are bluish grey at each extremity, and white in the middle. He also says that "it spins a bed of silk so tightly stretched from one edge of a leaf to the other as to bend it up, so that a section of it would represent a bow, the silk being the string. On this elastic bed the larva reposes, the fore parts of the body drawn in so as to swell out that part of the body on which the eye-spots are very conspicuous." "Before it spins its button and suspending girth, it gradually changes colour to a dingy purple." The larva may be found in July and September. The Chrysalis is brown with many darker blotches, and has a conical point on the breast. This Butterfly appears twice in the year, those of the first brood having passed the winter in the pupa state. It is abundant throughout Canada and the United States from end of May to end of July, and is found from Newfoundland to the Gulf of Mexico, and perhaps further.

In the early part of a Canadian summer, when the fragrant Lilacs are in full bloom, it is a glorious sight to see the tiny Humming birds flying over the blossoms in company with this splendid Butterfly, which is very partial to the flowers of that plant. It has, like many other species, a habit of assembling in numbers round wet places on roads, &c., and Mr. Gosse speaks of as many as fifty-two being seen together in one spot.

Explanation of the technical terms used in the description of the Butterflies:—

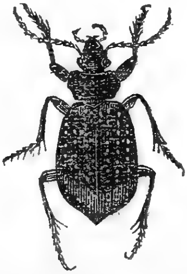
Outline of Wing. — *Costa*, the front edge of each wing—*base*, the part of the wing nearest the body—*hind margin*, the edge furthest from the body—*inner margin*, the edge opposite the costa—*tip*, the part where the costa meets the hind-margin—*anal angle*, where the hind-margin meets the inner-margin.

Markings.—*Longitudinal*, extending in the direction from the base to the hind-margin of the wing, or from the head to the tail of the insect—*transverse*, extending from the costa to the

inner-margin of the wing, or from one side of the body of the insect to the other—*spot*, a regularly shaped marking of moderate size—*dot*, a minute round spot—*band*, a transverse marking, wider than a line and of uniform width—*line*, a fine thread-like marking, of uniform width—*streak*, *stripe*, an elongated marking not necessarily of uniform width—*lunule*, a crescent-like mark or spot—*abbreviated*, cut short—*anal*, of or belonging to the tail or that end of the body opposite the head—*anterior*, that which is in front or nearest the head—*before the middle*, between the middle and the base of the wing—*behind*, *beyond the middle*, between the middle and the hind-margin of the wing—*bimucronate*, having two sharp points—*concave*, that which is hollowed out, when the margin of the wing is curved inwards—*convex*, when the margin of the wing is curved outwards—*denticulated*, toothed or notched—*dorsal*, of or belonging to the back—*fulvous*, orange-tawny, or orange with a brownish tinge—*furcate* with two prongs or forked—*lateral*, of or belonging to the side—*oblique*, that which goes in a slanting direction—*ocellated* that which has a spot with a pupil, or eye-like centre—*ventral*, of or belonging to the belly.

Parts.—*Antennae*, the horns—*medial nervure*, the middle rib vein, or nervure, between the costa and the inner margin—*nervure*, rib, vein, or nerve, the framework of the wing—*palpi*, the feelers, parts of the mouth—*segments*, rings or divisions of the body of the insect (a caterpillar consists of thirteen segments numbered from the head which is the first)—*spiracles*, *stigmata*, the breathing holes of the caterpillar placed along the sides above the feet—*tarsus*, the terminal portion of the leg—*tentacles*, (in the caterpillar) feelers like those of snails, &c.—*thorax*, the second part of the trunk or body, that part to which the wings are attached—*tibia*, the third portion of the leg — *tubercles*, small wart-like protuberances—*ungues*, claws.

NOTE. I had not an opportunity of examining a sufficient number of specimens, of the common Lackey or Apple moth, which is so destructive to the foliage of the trees round Montreal, to determine with accuracy the species to which it belonged, until after my article on "insects injuring the crops in the vicinity of Montreal" was in type. Having lately compared recently captured specimens with the descriptions in Dr. Fitch's reports, I have come to the conclusion that it is *Clisiocampa Sylvatica*, (Harris) and not *C. americana* as previously stated. The date of the article also was accidentally omitted. It was communicated to the Natural History Society, at its monthly meeting, June 29th. To enable non-entomologists to recognise that useful insect *Calosoma calidum*, I subjoin a short notice and discription of it.



Calosoma Calidum. *See page* 163.

This fine beetle belongs to the first division (Geodephaga) of the order of Coleoptera. The geodephaga or carnivorous ground beetles are so termed from their habit of living principally on the ground, and feeding in all their stages on other insects. The division is divided into two families. 1st. Cicindelidæ or Tiger Beetles, several species of which are very abundant about Montreal, flying in the sun on sandy places; and 2nd. Carabidæ which includes all the other geodephagous insects. There are a vast number of species in this country, all more or less useful in keeping down the numbers of noxious insects; but the present, conspicuous from its large size and great strength, is the most beneficial to us. The genus *Calosoma* to which it belongs contains many large species and most are splendidly ornamented with metallic tints. A great number of the Carabidæ are destitute of wings under the elytra, but this species and the rest of its genus are amply provided with the organs of flight, which enables them to follow their insect prey with greater facility on trees as well as on the ground. CALOSOMA CALIDUM, copper spot carab; black, all the joints of the antennæ except the four basal ones clothed with piceous hairs; sides of the thorax and elytra minutely punctured; the punctures green; elytra deeply punctate-striated, each with three rows of deep impressions, and one or two (sometimes more) at the base near the suture, of a brilliant copper colour. Length from ten to twelve lines. Professor Emmon's figure in his work on the Insects of New York is so bad that it is impossible to identify it.

Montreal, July 23, 1857. W. S. M. D'URBAN.

The American Association for the Advancement of Science.— The advent of the distinguished men who constitute the members of this society, and the other illustrious foreigners who have been invited to meet them in the city of Montreal in August next, will be one of the most important and interesting events that has ever occured in Canada. We well remember when, at a meeting of the Council of the Natural History Society held during the winter of 1856, the propriety of appointing a delegation to represent the Society at the Albany meeting of the Association, was suggested and proposed. And when its present President, Mr. Principal Dawson, hinted that Montreal would do well to invite the *savans* to make that city their next place of meeting, we recollect the doubts that were expressed and the difficulties that were thought to lie in the way of such an offer being accepted. It was said for example, that the American members would never consent to the Association assembling on this side of the line '45°, and it was strongly urged, certainly with more of truth than poetry in the argument, that the Natural History Society, a paralysed, helpless and almost hopeless institution, struggling hard for its very existence, to invite an Association so active and energetic, so distinguished and so full of vitality, would not only be a shock to modesty, but a proceeding which if favorably received, would place the Society in the most awkward difficulty of providing ways and means in accordance with its obligations, to accommodate and entertain the Association so invited. The dissentients were hard to satisfy, but they were at length convinced. The quiet but telling and practical arguments of the President brought them over. There was no knowing what might be the results of such a meeting, what its good effects alike to the aged professor and the very tyro in science. To bring here so many of the learned in this continent to meet together in social communion, for the interchange of great thoughts, would re-animate the dry bones of our society and make it again live. The excitement would not pass at once away; the influences would not be transient, but abiding; they would be with us long; we trust they will never leave us; and that (to use the words of an eminent philosopher speaking of the great sister Society, the British Association,) whether the mathematician's study, or the astronomer's observatory, or the chemist's laboratory, or some rich distant meadow unexplored as yet by botanist, or some untrodden mountain top, or any of the other haunts and homes and oracular

places of science, be our allotted place of labour, till we meet together again, these influences will operate upon us all, and make us look foward with joyful expectation to our next re-assembling, and by the recollection and the hope, be stimulated and supported.

The delegation, having been named, and furnished with full powers by the society, and the city Corporation having appointed a committee to co-operate with us, and unite in the letter of invitation, proceeded to Albany to discharge its important trust. The author of this notice having had the honor of being appointed one of the delegates, can speak from personal experience of the hospitality with which they were received, and the marked kindness and attention they experienced at the hands of the local committee. Nor was *he* less struck by the enthusiasm elicited by the concourse of congenial minds, there assembled—the friendships formed and cemented—the trains of experiment first suggested, or prosecuted anew after being long abandoned; above all, the awakening of the public mind to the just claims of science, as shewn by the large and crowded, and attentive audiences who frequented the rooms, and the anxiety of the press to obtain and publish detailed and lengthy reports of the proceedings. Montreal was not without a rival for the honor she coveted. Baltimore, the monumental city, had even been before her in the field, and had sent a delegate to present her claims, (Professor Steiner) whose eloquence, not less powerful than was his gentlemanly deportment and manners winning and pleasing, we were afraid, would carry the day. The permanent committee declined making the decision, and referred it to the Association at large. In the course of the discussions in the different sections some of our Montreal *savans* highly distinguished themselves. Sir Wm. Logan, Principal Dawson, Professor Smallwood, and Mr. Hunt contributed many valuable papers, and took prominent parts in the scientific subjects discussed, and we have no doubt this aided much in influencing the decision. Our Baltimore opponent agreed that whoever had the majority of voices should move that the decision be declared unanimous; and Montreal happily proving the favourite, Professor Steiner in most complimentary terms moved as he had proposed. The motion was agreed to amidst loud applause, and we need not say how proudly exaltant was the delegation at its certainly unlooked for success.

The Local Committee held its first meeting in Montreal in

September last, and having appointed a Secretary, proceeded to add to its number some sixty of our chief citizens. These consist of some of the Judges of the land, and members of the Bar, Clergy, and members of the Medical Profession, Lieut. Col. Munro, C. B., of the 39th Regiment, some of the Editors of the Local papers, and our principal city merchants. Meetings of the Committee have been held monthly until now, the middle of July, when it has been decided to assemble weekly until the 12th of August, the day of the meeting. The general committee has been divided into five sub-committees: 1st Conveyance; 2nd. Invitation and Accomodation; 3rd. Places of meeting and access to Public Institutions, &c.; 4th Printing and Post Office; and 5th Finance. These Committees have all been hard at work making the necessary arrangements in the respective departments entrusted to them, and the diligence with which they have acted and the encouragement and assistance they have received from all quarters makes us believe that the meeting will be a most successful one, and that Montreal is fully alive to its importance.

The Government of Canada, following the example of the State authorities at Albany, have granted £500 to assist in the celebration; eleven free passages have been given by the owners of the ocean lines of steamboats; the different railroads and steamboats both here and in the United States have consented to carry the members of the Association to and from Montreal for one fare; and a subscription has been already set on foot by our citizens which promises to reach a large and liberal amount. The morning sessions of the Association, and its sectional meetings will be held in different rooms in the new Court House; the evening entertainments will be given in the Bonsecours Hall, these buildings having been placed at the disposal of the committee, gratuitously for this purpose. The meetings are all open to the public, free of charge. The Standing Committee will assemble in the Library of the Natural History Society, Little St. James Street. The Governor General, Sir Edmund Head, himself a scholar of no mean pretentions, has taken a great interest in the success of the meeting, and it is to be regretted that his absence in England, which will likely be prolonged until October, will prevent his being present personally, and taking a part in the proceedings. Invitations have been sent to eminent *savans* in Great Britain and on the European Continent, to the number, including Learned

Societies, of about 250. It is cause of much regret that the proportion of these, who have responded to the invitations and are likely to attend, is so small; but the length of the voyage, the time that it necessarily must occupy, and the very few free passages placed at the disposal of the Committee have all in some degree contributed to lessen the number. The fact of the British Association holding its meeting during the same month, and the engagement so many of the European celebrities have contracted in respect thereof, has also been a great drawback to the attendance of the foreigners invited. But we are proud to say that among those whom we have good reason to expect will be present on the occasion, are Sir R. J. Murchison, Director general of the Geological Survey of Great Britain; Col. W. J. Hamilton, M. P., ex-president of the Geological Society of London; Dr. Seaman, delegate from the Linnean Society of London; and Sir Wm. Hooker, of the Royal Botanical Gardens.

Before concluding this brief notice of an Association which we are now so actively preparing to receive, it may be well to reply to a question which some will be sure to ask, viz: how this Association differs from its fellows, and what peculiar means it has of awakening and directing to scientific purposes the power of the social spirit; or why, when there were so many old and new societies for the advancement of science, it was thought necessary and expedient to call this society into being. To say that in this respect it has but followed the example set it by the older and more celebrated institution in our father land, would, to all who understand the benefits and advantages accruing to science and the world at large from the labor of the members of that distinguished association, be explanation enough, especially when added to the fact that we live in a comparatively new country, and that in scientific investigation and research we are but beginners. But it is well to condescend a little more, and in doing so, in preference to any language of our own, we condense and apply that made use of by Sir Wm. Hamilton when answering similar queries made elsewhere.

The American Association, then, as an Association, differs in its magnitude and universality from all lesser and more local societies. What they do upon a small scale, it does upon a large; what others do for Montreal, Toronto, or New York, this does for the whole American continent. Its gigantic arms stretch even to Europe and India; and the joy with which it welcomes to its

assemblies and its hospitality those eminent strangers who come from foreign lands, rises almost above the sphere of private friendship, and partakes of the dignity of a compact between all the nations of the earth. But it is not merely in its magnitude and universality, and consequently higher power of stimulating intellect through sympathy, that this Association differs from others. It differs also from them in its constitution and details; in the migratory character of its meetings, which visit, for a week each year, place after place in succession, so as to indulge and stimulate all, without wearying or burdening any; in encouraging oral discussion, throughout its several sections, as the principal medium of making known among members the opinions, views and discoveries of each other, in calling upon eminent men to prepare reports upon the existing state of knowledge in the principal departments of science; and in publishing only abstracts or notices of all those other contributions which it has not, as a body, called for; in short, in attempting to induce men of science to work more together than they do elsewhere, to establish a system of more strict co-operation between the labourers in one common field, and thus to effect, more fully than other societies can do, the combination of intellectual exertions. The *discussions* in its sections are more animated, comprehensive and instructive, and make minds which were strangers more intimately acquainted with each other than can be supposed to be the case in any less general body; the *general meetings* bring together the cultivators of all different departments of science; and even the less formal *conversations* which take place in its halls of assembly during every pause of business, are themselves the working together of mind with mind, and not only excite but *are* co-operation.

It is this personal intercourse with the great scientific and learned men of the age, which in itself constitutes the principal charm of such meetings. How, for instance, would we have delighted to listen to a Newton, had he condescended to converse on the great truths of Astronomy; to a Jussieu, imparting to a circle of inmates in his own garden at Trianon, those glimpses with respect to the natural relations of plants, which he found it so difficult to reduce to writing; or to a Linnæus, discussing at Oxford his then novel views with respect to the vegetable kingdom, and winning from the reluctant Dillenius a tardy acknowledgment of their merits? These great men have passed away; but we have others, in their own sphere and degree, who, when

they in turn shall have gone to that spirit world where things are seen, not as through a glass darkly, but face to face, shall in the world beneath occupy niches—if humbler ones—in the temple of fame. This

> is the spur that the clear spirit doth raise
> To scorn delights, and live laborious days.

And look where we will, from the highest and most solitary sage who ever desired the "propagation of his own memory," and committed his lonely labors to the world, in full assurance that an age would come, when that memory would not willingly be let to die, down to the humblest laborer who was ever content to co-operate outwardly and subordinately with others, and hoped for nothing more than present and visible recompense, we still perceive the operation of that social spirit, that deep instinctive yearning after sympathy to use the power, and (if it may be done) guide the influences of which, this Association was framed.

We trust, then, that the Montreal meeting will not be inferior to former assemblings, but will more than realize our hopes and wishes, and not only give a new impulse to science among us, but also cement the kindly feeling which binds the members together already.

A. N. R.

NATURAL HISTORY SOCIETY OF MONTREAL.

The Annual General Meeting of this Society was held in the Museum, on Monday evening, the President, J. W. Dawson, Esq., F. G. S., in the Chair. The members present were the Lord Bishop of Montreal, Rev. A. Kemp, Rev. A. D. Campbell, Rev. A. DeSola, Dr. Fraser, Dr. Jones, Dr. Barnston, L. A. H. Latour, J. T. Dutton, H. Rose, J. H. Joseph, W. H. A. Davies, D. Robertson, J. Ferrier, jr., N. S. Whitney, R. Scott, E. Murphy, Dr. Howard, Dr. Hingston, Dr. Fenwick, B. Chamberlin, A. N. Rennie.

REPORT FOR 1857.

Your Council in submitting the annual Report of the proceedings and progress of the Society for the years 1856–7, find no difficulty in discharging this duty from lack of materials, as the subjects which have engaged their attention have been both numerous and important. Our predecessors rendered an important service to the Society, by their concise sketch of its history contained in the last report—a proceeding often necessary, in order

to mark out the progress of any public Institution, and to call the attention of its supporters to its first principles and objects. Your Council, therefore, feel that they cannot do better than take up the subject as they received it, and continue the narrative down to the present time.

The first subject which engaged the attention of the Society during the past year, was the appointment of a Committee to be its representative at the Annual Meeting of the American Association for the advancement of Science, held at Albany in the month of August last, and to solicit the selection of Montreal as the locality for the next annual assembly of that distinguished Society. A Committee was also appointed to consult with the City Corporation and with influential citizens to obtain their concurrence and assistance in accomplishing this purpose. Your Council have much pleasure in reporting that the labors of both Committees have been crowned with complete success. Your deputation was received with the utmost cordiality by the Association. Their invitation was unanimously accepted. The representatives of other cities, especially those of Baltimore, seeing the general desire of the Assembly to meet in Montreal, in the most honorable manner withdrew their claims for the time.

A large local Committee has been organised for the purpose of making the necessary arrangements for receiving and entertaining the Association, and is now actively engaged in this work. Influential private individuals have come forward to assist in various ways to facilitate and complete the arrangements necessary for this important undertaking. The Society's sister Institution in Toronto has also most honorably offered to co-operate with us in carrying the project to a successful issue. The Government and influential members of the Legislature have taken a deep interest in the matter, as likely to promote the progress of science in the Province, and have indicated their purpose to do what lies in their power to render this meeting popular and beneficial. Some of the Railroad and Ocean Steamship Companies have granted valuable assistance in the form of free passages to scientific gentlemen invited by the Local Committee from different quarters, to take part in the proceedings of the Association.

Your council anticipate from the respectability, efficiency and zeal of the Committee to which the American Association have intrusted the necessary preparations for their meeting in August next, that the result will largely contribute to the interests of this

Society, by stimulating its future efforts in the cause of science. Your Council therefore feel that it is unnecessary for them to urge upon the members of this Society the necessity of cordial unanimity and zeal in their exertions to contribute to so desirable an object. The Council entertain a confident hope that the contemplated meeting of the American Association for the Advancement of Science will be as successful as any that has yet been held.

With a view to promote the efficiency of the Society, and in compliance with the recommendation of their predecessors, Committees were last year appointed for the purpose of arranging the collection in the Museum, and of furnishing original investigations and papers in their several departments. Your Council are happy to report that, so far, this arrangement has been productive of good results; among which they would specially mention a valuable paper from the Committee appointed to report upon the method of rearing fish from the ova, the recommendations of which they trust, will be carried out as soon as practicable.

The Society at its meetings in the early part of the year having also taken into consideration the state of its building, and deeming it unsuitable for the present wants of the institution, resolved to take measures for the erection of new premises if a suitable site could be procured. A Committee was accordingly appointed to make enquiries. From the report of that Committee it was found that a sufficient sum of money to purchase an eligible site and to erect a suitable edifice could not be obtained from the sale of the present property. Enquiry was therefore made whether the grant of a free site might not be obtained. As the result of this, your Council feel great pleasure in being able to report that the Governors of the McGill College have made a very handsome offer to the Committee, of a lot of land on University and Cathcart Streets, 90 feet by 50, on terms which are equivalent to a donation, and which the Committee reported as the most eligible site that could be obtained. Your Council, under this impression, adopted the Report, and proceeded to make arrangements for the disposal of the present building, and the erection of a new one, hoping that this might be effected before the meeting of the American Association. Plans of a new building were accordingly prepared and submitted to a special Meeting of the Society. However it was found that the sum of £2000, for which the Council were authorized to dispose of the building, would not be sufficient for the purpose contemplated; it was,

therefore, determined to raise £500 in addition, by private subcriptions, amongst the members and friends of the Society. Your Council are happy to report that £250 has already been subscribed, and they entertain a lively hope that the balance will be obtained by their successors so as to complete the work they have had the honor to commence. In order to obtain sufficient means to cover all the expenses of removal, and to enable the Society to open its new erection, with their Natural History collection arranged and perfected, your Council drew up, and presented through H. H. Whitney, Esq., M. P. P., a petition to Parliament, for a more liberal anunal grant to the Society. They are happy to report, that their petition has been so far successful, and that a sum of £500 has been granted by Parliament to meet the extraordinary expenses of the Society on account of the approaching convention. Your Council further expect that should the decision of her Most Gracious Majesty in Council be that Montreal shall be the seat of the Provincial Government, property will so increase in value as to enable their successors to dispose of the premises to greater advantage than could be done at present, and thus enable them more fully to realize the wishes of the Society. In connection with the new erection, the Council recommend the establishment of an Observatory if at all practicable and if sufficient means can be got to maintain it. Your Council have to regret that the revision of the Constitution and Bye laws, which have been effected at the cost of much labor, yet waits the confirmation of the Members. They are, therefore, obliged to leave so important a work, in its unfinished state, to their successors. The Society has been favored with several valuable donations during the year, for which thanks have been conveyed to the donors.

The Council have great pleasure in announcing that there has been a large increase in the number of members—*eighteen* corresponding and *thirty* ordinary members having been elected during the past year. It is wih regret that they are called upon to record the loss, by removal to Toronto, of Dr. Workman. His departure from the city has deprived the Council of a painstaking treasurer and a most efficient member, and the Society of one of its oldest and firmest supporters. They beg also to note that the services of Dr. Wright, Curator for a period of three years, in arranging the Museum and the Library, are worthy of the thanks of the Society.

The title of honorary member has been conferred upon the Lord Bishop of Montreal, Sir Wm. Logan, Knt., L.L.D., F.R.S., F. G. S., Charles Smallwood, Esq., M.D., L.L.D., F.M.S., &c., &c., Professor Mitchell, of Cincinnati, ProfessorHall, Albany, Professor Dunglison, Philadelphia.

The course of lectures annually delivered under the auspices of the Society commenced on the 22nd January, and were remarkably well attended by the public generally.

The Introductory Lecture was delivered by Principal Dawson.

2nd Lecture—Thursday, 29th Jan.—by E. Billings, Esq. Subject: " The Geology of the Ottawa Region."

3rd Lecture—Thursday, 5th Feb.—By T. S. Hunt, Esq. Subject: " Natural History of the Alkalies."

4th Lecture—Thursday, 12th Feb.—By Rev. A. DeSola. Subject: Scripture Zoology."

5th Lecture—Thursday, 19th March.—By Jas. Barnston, M. D. Subject.—" General view of Vegetable Life."

6th Lecture—C. Dutton, Esq. Subject: "Balænus Mysticus."

The Council feel greatly indebted to those gentlemen for their valuable services on those occasions, and congratulate the Society on the interest taken in the lectures by the public. They hope that the next Course may be on a larger scale, held in a more convenient room, and attended by a still larger number of persons.

The Council regret that from various reasons they have not been able to carry out so fully as they could have wished the recommendation of their predecessors, to obtain the reading and discussion of Monthly Essays or Papers, one paper only having been submitted; but they trust that the Meeting of the American Association and the greater facilities for acquiring a knowledge of Natural Science now enjoyed in this city, will have the good effect of calling forth greater scientific exertions in future.

The Council have much pleasure in reporting that L. A. H. Latour, Esq, 1st Vice-President, has during the year offered a Gold Medal as prize, for the best Essay in French or English on any subject of Canadian Natural History. They beg to recommend to their successors the appointment of a Committee to receive the Essays that may be offered, and to adjudge the Prize on the 1st August next. This measure, your Council trust, will call forth much latent talent, and advance the objects of the Society, while it rewards with honor the successful candidate, and realises the liberal and praiseworthy intentions of the donor.

Your Council also report that Mr. Billings, late of Ottawa, a Corresponding Member of the Society, having come to reside permanently in Montreal, has expressed a wish that the Society should take a part in the publication of "The Canadian Naturalist and Geologist," so successfully conducted by him during the past year. This offer was favorably received by the Society, and a Committee was formed to carry out this object and to open a subscription list for the issue of the second volume under the title of the "Canadian Naturalist and Geologist, and Transactions of the Natural History Society of Montreal." Another Committee was appointed to superintend its publication, of which Mr. Billings himself undertakes a part. Your Council are happy to say a first number has been printed under very auspicious circumstnces, and they trust that this undertaking will meet with complete success.

Your Council have not considered it prudent at present to solicit from the Legislature a Copy Right Law, to compel publishers to contribute a copy of every publication to the several Literary and Scientific Institutions of the Province. The law as regards copyright is yet in an undecided and unsettled state, and they recommend that the matter receive the consideration of their successors.

The Council are sorry to announce that Mr. Broome, so long the Janitor of the Society, died after a brief illness a few months ago, and they have from various considerations deemed it proper for the present, to continue the services of his widow, as keeper of the premises, which they trust will meet with the approval of the Society.

The accompanying Reports of the Treasurer, Librarian and Cabinet Keeper, will present an account of the condition and prospects of the Finances, the Library, and the Museum.

In view of the meeting of the American Association in August, and of the necessity of arranging and presenting the subjects of the Museum in the best and most scientific order, the Council have engaged the services of J. M. D'Urban Esq., a young Naturalist of considerable attainments and ability, for six months as Assistant Curator. As however the collection cannot be rendered complete or properly arranged without considerable expense, which the present ordinary income of the Society will not sufficiently afford, it has been resolved to meet the additional expenditure by applying to this purpose any special funds that may be obtained.

In surrendering the important interests which have during the past year been confided to them, your Council experience much satisfaction in reviewing the activity and energy of the Society. A measure of progress has marked the history of this valuable Institution—an accession of scientific talent has been acquired, and much important literary and other labour has been undertaken. As the coming year appears destined to be one of considerable promise in promoting the aims of the Society, your Council beg to express a hope that its zeal and energy in the cause and promotion of Science may be crowned with complete success, and may largely contribute to foster that spirit of earnest investigation into the phenomena of nature which so eminently distinguishes the present age.

In conclusion, the Council have to express their gratitude for the liberal aid given by the Government in consideration of the invitation extended to the American Association. The Council recommend that a portion of this sum be expended in arranging and improving the Museum, in providing an entertainment for one of the evenings of the meeting, and that the balance be reserved for any aid that the Society may be called upon to contribute towards the success of the meeting.

A Report from the Treasurer showing a balance in hand of over ten pounds was also read; as was a Report from the Curator of the Museum, on the state of the Society's collection, and the donations made to it during the past year.

On motion of Dr. Barnston, seconded by Dr. Jones, it was resolved that the Reports now read be received and adopted, and referred to the Council for early publication.

ELECTION OF OFFICE-BEARERS.

The President having appointed Drs. Fraser and Barnston as Scrutineers, the meeting proceeded to ballot for Office Bearers and Council. The following was declared the result:—

President, J. W. Dawson; 1st Vice-President, L. A. H. Latour; 2nd Vice-President, Sir W. E. Logan; 3rd Vice-President, E. Billings; Corresponding Secretary, W. Hingston, M. D.; Recording Secretary, A. N. Rennie; Treasurer, James Ferrier, jr.

Cabinet Keeper and Librarian—Jas. Barnston, M. D.

Members of Council.—Rev. A. F. Kemp, Dr. Fraser, Rev. A. DeSola, Dr. Jones, and H. Chapman.

Library Committee.—Dr. Wright, D. A. Poe, H. Rose, N. S. Whitney.

Mr. J. M. D'Urban was appointed Assistant Curator to the Society; and the following gentlemen named as the Editing Committee of the Canadian Naturalist; Messrs. Dawson, Billings, Poe, Hunt, Hingston, Barnston, and Rennie.

On motion by Dr. Jones, seconded by Mr. Billings, it was resolved :—

That the thanks of the Society are hereby given to the retiring Office-bearers and Council, for their valuable and efficient services during the past year.

On motion by the Rev. A. D. Campbell, seconded by Mr. Dutton, it was resolved :—

That the best thanks of this meeting are due to H. H. Whitney, Esq., M.P.P., for his kind and valuable services in furtherance of the Society's Petition, for a supplementary grant, and that the Recording Secretary be directed to forward a copy of this resolution to the Honorable Member.

It was also moved by the Rev. A. D. Campbell, seconded by L. A. H. Latour, and resolved—That the sum of twenty-five pounds be granted to the Recording Secretary for incidental expenses, and obtaining the necessary assistance connected with the approaching Scientific Convention.

The President having left the chair, which was taken by Dr. Barnston,

The Rev. A. F. Kemp, in a highly complimentary speech, proposed a cordial vote of thanks to Prof. Dawson, for his able, efficient and zealous services during the past year. The motion was seconded by the Rev. A. DeSola, and carried by acclamation. The President briefly but appropriately acknowledged the compliment, and the meeting broke up.

A. N. RENNIE, *Rec. Sec.*

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF AUGUST, 1857.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29·569	29·533	29·655	62·7	66·0	60·6	·528	·516	·511	·93	·80	·93
2	614	620	798	60·0	76·7	65·6	·512	·692	·586	·91	·78	·93
3	734	704	898	62·2	81·0	68·8	·528	·739	·634	·93	·71	·90
4	754	712	608	66·1	87·7	70·6	·574	·814	·541	·89	·65	·74
5	643	700	726	63·2	87·9	62·5	·461	·801	·499	·29	·62	·89
6	812	835	949	59·6	86·0	59·0	·478	·648	·452	·90	·53	·89
7	967	915	999	56·5	88·1	68·0	·488	·692	·582	·89	·53	·85
8	848	749	891	64·4	83·0	64·0	·565	·715	·476	·93	·64	·79
9	980	970	846	55·6	72·5	58·0	·552	·498	·437	·79	·64	·89
10	685	552	491	58·0	79·2	64·2	·482	·659	·505	·90	·67	·63
11	857	468	596	62·0	70·3	62·6	·528	·541	·499	·93	·74	·89
12	696	700	724	48·1	78·0	64·0	·334	·607	·504	·93	·64	·84
13	676	712	446	63·0	70·0	63·0	·546	·659	·545	·94	·80	·94
14	417	524	551	67·0	84·0	67·3	·626	·854	·593	·93	·74	·89
15	641	714	830	65·0	76·0	58·0	·529	·659	·437	·85	·74	·89
16	858	778	30·005	55·0	71·0	57·2	·372	·559	·376	·84	·74	·76
17	811	746	29·688	48·7	68·0	49·6	·366	·552	·226	·92	·81	·88
18	813	741	764	47·0	72·0	54·7	·313	·578	·373	·92	·74	·87
19	800	714	817	47·0	74·1	57·1	·313	·618	·398	·93	·78	·84
20	806	672	856	67·4	73·0	58·9	·447	·692	·478	·94	·86	·92
21	917	915	954	61·0	76·6	60·6	·520	·597	·441	·96	·67	·84
22	817	720	666	55·6	72·1	61·0	·418	·578	·483	·93	·74	·89
23	517	358	404	57·4	71·6	61·0	·447	·681	·512	·93	·89	·96
24	527	511	783	53·2	63·5	51·1	·361	·548	·337	·87	·93	·87
25	928	868	902	55·0	78·7	65·0	·396	·670	·555	·89	·71	·89
26	925	900	883	37·0	79·7	65·5	·449	·692	·555	·94	·71	·89
27	880	786	614	64·0	86·0	70·1	·565	·510	·525	·95	·75	·86
28	377	344	485	65·0	79·9	68·0	·589	·692	·613	·93	·71	·89
29	504	521	624	66·0	68·0	60·0	·514	·590	·467	·89	·86	·89
30	681	679	746	48·2	66·6	60·7	·312	·449	·467	·86	·68	·89
31	817	883	30·052	60·1	73·6	50·6	·441	·568	·349	·84	·71	·92

	Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	S. W.	W. S. W.	S. W. by S.	7·22	2·96	1·11	0·540		Cirr. Str. 10.	Nimb. 10.	Cirr. St. 2. Thunder.
2	S. W. by W.	S. W. by W.	S. W. by W.	0·22	1·42	2·16	Inapp.		" 7.	C. C. Str. 6.	C. C. St. 2.
3	S. E.	S. by E.	S. E. by E.	0·12	0·18	0·40			Clear.	C. Str. 4.	C. Str. 3.
4	S. S. W.	S. S. W.	N. N. W.	0·00	0·35	0·30				" 2.	" 10.
5	N. by E.	N. by E.	N. W. by W.	6·57	3·06	4·65			C. Str. 10.	" 2.	Clear,
6	E. N. E.	E. by N.	S. E.	3·16	2·08	0·10			Clear.	Clear.	"
7	S. S. W.	S. W.	S. by E.	0·48	0·43	0·10			"	"	C. Str. 2.
8	S. by W.	W. S. W.	W. N. W.	0·66	7·21	8·77			C. C. Str. 10.	C. Str. 9.	Clear.
9	W.	N. E.	S. S. W.	9·75	4·87	0·21			Clear.	Clear.	Str. 2.
10	S. S. E.	S. by E.	S. W. by S.	0·00	1·90	1·16	Inapp.		C. C. Str. 6.	C. C. Str. 8.	Cum. St. 10. Dis. Thunder
11	W.	N. W.	N. by W.	1·30	6·31	3·90	0·274		C. Str. 10.	C. Str. 4.	" 6. "
12	W. by S.	S. S. W.	S. E.	0·36	6·40	2·60			Clear.	Clear.	" 2.
13	S. S. E.	N. E.	N. E.	3·71	1·40	1·42	1·079		C. Str. 10.	C Str. 9.	" 10.
14	W. by S.	W. N. W.	W. N. W.	1·05	5·30	9·65			" 10.	" 6.	Clear.
15	N. by W.	W. N. W.	W. by W.	0·21	5·63	8·27			" 6.	Clear.	"
16	W. by N.	W. by S.	W.	6·40	9·52	5·93			Clear.	Str. 2.	C. Str. 8.
17	N.	N. E. by E.	W. by N.	0·20	3·17	4·12			C. C. Str. 6.	Clear.	Cirr. Str. 4.
18	N. E. by E.	N. E.	N. E.	1·00	0·69	0·86			" 4.	C. C. Str. 8.	Clear.
19	S.	S.	S. by E.	1·32	1·15	1·25			C. Str. 2.	C. Str. 10.	Nimb. 10.
20	N. E.	S. W.	W. S. W.	2·11	0·37	1·40	1·200		Str. 10.	" 6.	C. Str. 2.
21	S. W. by S.	S. E.	S. by E.	0·13	0·17	0·86			C. Str. 8.	C. C. Str. 4.	Clear.
22	S. S. E.	S. by E.	S. E.	1·28	5·91	9·51	Inapp.		C. Str. 10.	Cirr. Str. 6.	C. Str. 10.
23	E. S. E.	S. by E.	S. S. W.	8·61	8·25	0·82	0·473		Cirr. 4.	" 4.	Clear.
24	W.	W. N. W.	S. W. by W.	7·78	10·55	9·43	Inapp.		C. Str. 6.	C. C. Str. 6.	"
25	W. by S.	S. W.	S. W.	6·05	3·27	3·70			Clear.	Clear.	
26	S. S. W.	S. S. W.	S. S. W.	1·63	4·52	5·06			"	"	Clear. Aurora Borealis.
27	S. S. E.	S. S. E.	S. by E.	6·02	0·63	9·30				C. C. Str. 2.	C. St. 10.
28	S. by E.	S. W.	S. S. W.	22·25	7·10	8·66	1·023		C. Str. 10.	C. Str. 10.	" 4.
29	S. W. by S.	W.	N. W.	2·18	7·63	4·65	Inapp.		" 4.	" 8.	C. C. St. 8.
30	W. by S.	W. by S.	W. S. W.	1·96	9·81	7·07			" 10.	Clear.	C. St. 4.
31	W. by N.	S. S. E.	S. E.	11·75	3·70	7·81			" 8.	C. Str. 4.	Clear.

REPORT FOR THE MONTH OF SEPTEMBER, 1857.

	Barometer			Temperature of the Air			Tension of Aqueous Vapour			Humidity of the Atmosphere		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	30·061	30·019	30·090	46·9	85·7	68·2	·282	·763	·582	·86	·65	·85
2	049	29·974	093	62·0	88·4	70·0	·472	·801	·628	·84	·62	·86
3	099	30·076	083	60·7	88·6	62·5	·511	·801	·516	·93	·62	·92
4	081	076	003	63·5	91·4	68·2	·526	·814	·616	·89	·59	·93
5	29·861	29·701	29·691	69·8	81·2	65·7	·668	·704	·605	·92	·68	·93
6	987	935	30·031	51·2	63·3	46·6	·315	·307	·282	·81	·53	·86
7	30·160	30·135	179	48·4	66·3	48·0	·281	·440	·302	·80	·68	·86
8	158	035	29·959	54·0	69·1	60·9	·304	·437	·456	·89	·62	·84
9	29·961	29·883	905	58·2	69·0	62·4	·462	·570	·472	·92	·81	·84
10	857	671	598	60·4	81·6	73·0	·494	·739	·692	·91	·71	·86
11	451	806	925	7·00	58·0	54·6	·628	·487	·400	·86	·89	·92
12	912	814	766	48·0	58·7	52·0	·302	·389	·349	·86	·79	·87
13	764	609	745	48·1	84·8	69·0	·281	·854	·634	·80	·75	·90
14	747	712	604	65·7	77·9	66·1	·586	·787	·605	·92	·86	·92
15	680	722	900	59·5	67·5	52·9	·452	·480	·373	·89	·72	·92
16	952	885	946	46·2	67·9	53·0	·282	·563	·361	·86	·85	·87
17	599	453	531	41·5	56·7	52·7	·235	·432	·386	·85	·94	·93
18	635	975	981	45·4	35·5	33·1	·253	·203	·187	·80	·91	·90
19	968	908	892	34·2	58·1	42·0	·170	·307	·243	·79	·75	·85
20	694	715	901	44·0	50·9	41·7	·241	·326	·263	·79	·87	·92
21	980	970	999	37·7	57·8	42·9	·218	·422	·263	·91	·89	·92
22	847	704	581	44·7	50·5	49·2	·261	·349	·356	·85	·90	·93
23	500	494	604	40·2	51·4	44·9	·227	·255	·261	·85	·66	·85
24	686	712	810	44·1	67·3	5·66	·282	·534	·432	·92	·81	·94
25	852	819	835	48·0	80·5	59·0	·291	·751	·432	·84	·75	·89
26	861	992	954	57·1	72·5	5·41	·422	·450	·349	·89	·58	·81
27	897	762	718	51·2	76·6	63·2	·361	·692	516	·92	·78	·89
28	574	580	583	57·0	51·7	48·0	·447	·315	·324	·94	·81	·92
29	754	759	852	39·0	47·0	36·0	·214	·271	·192	·84	·80	·83
30	868	840	857	34·0	52·0	38·2	·186	·274	·226	·87	·70	·90

	Direction of Wind			Mean Velocity in Miles per hour			Amo'nt of Rain	Amo'nt of Snow	Weather, Clouds, Remarks, &c.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	S. W.	S. W.	S. W..	0·20	5·61	3·06			Clear.	Clear.	Clear.
2	S. W.	S. S. W.	S. by W.	1·46	1·72	0·30			"	"	Cirr. Str. 2.
3	S. by W.	S. by W.	S. by W.	0·46	0·17	0·35			Str. 2.	"	Clear. Aurora Borealis.
4	S. by W.	S. S. E.	S. S. E.	0·15	0·05	0·00			Clear.	"	Cirri. 2.
5	S.	S. W.	W. N. W.	0·00	6·16	10·11	1·001		"	C. Str. 9.	C. Str. 8. Thunder storm.
6	N. W.	N. W.	N. W.	10·15	17·77	8·30			Str. 1.	Str. 2.	Clear.
7	N. W.	S. W.	S.	1·26	0·63	0·73			Clear and Frost.	" 1.	"
8	W.	W. S. W.	S. W.	0·15	4·99	5·33			C. Str. 8.	C. Cirr. 4.	C. Str. 9. Thunder.
9	W. by S.	N. W.	E. S. E.	4·50	1·20	0·21	0·140		" 6.	C. Str. 10.	Clear, Lightning.
10	E. N. E.	W. by S.	W. S. W.	0·26	15·22	3·96	0·133		" 10.	Clear.	Clear, Aurora Borealis.
11	W. by S.	N. E. by E.	E. by N.	5·00	10·20	0·96	0·104		" 3.	Rain.	C. Str. 8.
12	N. E. by E.	N. E.	N. E.	6·78	8·12	12·05			" 9.	C. Str. 8.	" 10.
13	S. E. by E.	S. S. W.	S. E. by E.	1·62	0·12	0·82			Clear.	Clear.	C. C. Str. 4.
14	S. S. E.	S. S. E.	S. S. E.	0·10	1·21	4·08	0.330		C. Str. 8.	C. Str. 2.	C. Str. 8. Lightning.
15	W.	N. N. W.	N. W. by W	12·42	16·50	2·00			" 6.	" 2.	Clear.
16	N.	S. by W.	W. S. W.	10·96	1·61	2·67			Clear.	" 4.	C. C. Str. 4.
17	N. W.	W. S. W.	W. S. W,	0·22	0·10	0·35	0·140		"	Rain.	C. Str. 9.
18	S, by E.	N W.	N. W.	0·92	18·77	3·77			C. Str. 10.	Clear.	Clear.
19	E.	E. S. E.	E.	6·57	0·47	0·08			Clear.	C. C. Str. 8.	"
20	E.	N.	S. W. by W.	1·97	6·15	1·70	0·210		Rain.	C. Str. 4.	"
21	S. S. E.	E. by W.	E. by S.	0·00	0·50	0·07			Clear.	" 2.	"
22	S. by E.	S. by E.	S. S. E.	0·86	2·27	10·32	0·720		C. Str. 7.	Nim. 10.	Rain.
23	W. by N.	W. by N.	W. S. W.	13·87	19·48	9·42	0·170		Clear.	C. Str. 2.	Clear. Aurora Borealis.
24	S. W.	W. by S.	S. W.	7·80	8·26	4·33			"	" 2.	"
25	S.	W. S. W.	S. by W.	0·98	5·89	1·22			"	Clear.	" " "
26	S. W.	W.	W. S. W.	1·52	6·90	3·71			"	"	"
27	S. by W.	[illegible] S.	S. by W.	0·35	3·82	7·00			"	"	" Lightning.
28	S. W. by S.	S. W.	S. W.	4·22	1·62	10·47	1·053		C. Str. 10.	Rain, Thunder.	C. Str. 9.
29	W. N. W.	W. by N.	W.	19·32	15·67	11·32			Clear.	C. Str. 6.	Clear.
30	W. N. W.	S. W.	S. W. by S.	1·90	4·80	2·71	0·170		"	" 8.	C. Str. 6.

REMARKS FOR AUGUST, 1857.

Barometer.
- Highest, the 31st day, 30·052 inches.
- Lowest, the 28th day, 29·344 "
- Monthly Mean, 29·723 inches.
- Monthly Range, 0·608 "

Thermometer.
- Highest, the 7th day, 90°4.
- Lowest, the 25th day, —45°2.
- Monthly Mean, 65°07.
- Monthly Range, 45°2.

Greatest intensity of the Sun's rays, 120°0.
Lowest point of Terrestrial radiation, —41°4.
Mean of Humidity, ·848.

Amount of Evaporation, 2·84 inches.
Rain fell on 11 days, amounting to 4·580 inches; it was raining 43 hours and 10 minutes, and was accompanied by Thunder on 3 days.
Most prevalent wind, S. W. Least prevalent wind, E. by N.
Most windy day, the 28th day; mean miles per hour, 12·45.
Least windy day, the 3rd day; miles per hour, 0·23.
The Electrical state of the Atmosphere has indicated rather feeble intensity.
Ozone was in large quantity.
Aurora Borealis visible on 1 night.

REMARKS FOR SEPTEMBER, 1857.

Barometer.
- Highest, the 7th day, 30·179 inches.
- Lowest, the 23rd day, 29·494 "
- Monthly Mean, 29·842 inches.
- Monthly Range, 0·685 "

Thermometer.
- Highest, the 4th day, 91°4.
- Lowest, the 19th day, 30°4.
- Monthly Mean, 57°47.
- Monthly Range, 61°0.

Greatest intensity of the Sun's rays, 121°2.
Lowest point of Terrestrial radiation, 29°8.
Mean of Humidity, 823.
Amount of Evaporation, 2·48 inches.

Rain fell on 11 days, amounting to 4·171 inches; it was raining 45 hours and 4 minutes, and was accompanied by Thunder on 3 days.
A few flakes of Snow fell on the 29th day, being the first this season.
Most prevalent wind, the W. S. W. Least prevalent wind, the N.
Most windy day, the 29th day; mean miles per hour, 15·43.
Least windy day, the 21st day; mean miles per hour, 0·19.
The Electrical state of the atmosphere has indicated rather high intensity.
Ozone was in moderate quantity.
Aurora Borealis visible on 5 nights.
First Frost on the 7th day.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOLUME II. SEPTEMBER, 1857. NUMBER 4.

ART. XXIV.—*Eleventh Meeting of the American Association for the Advancement of Science.*

The American Scientific Congress has just closed its sitting in our good Canadian City of Montreal, effecting a virtual Scientific annexation of American to British American minds, in their action in the wide field of physical and natural science. The Meeting has been a highly successful one, creditable alike to the assembled science of America, and to the city of Montreal, and we trust will produce lasting good effects, unalloyed by those small jealousies and heartburnings that too often remain after great assemblies of men, whatever the objects in which they may have been engaged.

We cannot attempt to present to our readers a full report of the proceedings of the Association. In its more ephemeral form this has been well done by the newspapers, and in its more permanent form it will appear in due time in the proceedings. We purpose merely to preserve a record of leading features of scientific progress evidenced in the meeting, and of points especially important to Canada. In doing so we shall draw largely on the reports in the Montreal newspapers, especially the *Herald* and *Gazette*; re-

ports which are in the highest degree creditable to those prints and could not easily have been surpassed in any part of America.

The opening Meeting was imposing and interesting. The Divine blessing was invoked on the proceedings by the Bishop of Montreal, in a singularly appropriate and beautiful prayer. Prof. Caswell, the Vice-President, who, owing to the lamented death of the great microscopist Bailey, was called to preside, delivered a short but happily conceived inaugural address, from which we extract the following sentences, as worthy of being embalmed in the memory of Canadians and Americans :—" It augurs well for the interests of Science that so many have come to this gathering to place their choicest contributions on her altar, and to welcome to her fellowship the humblest laborer in her cause. I think also that it is a matter of congratulation that we have met without the limits of the United States. However it may have been in former times, it is not now the case that mountains or seas interposed make enemies of nations. In the onward march of Science, it is one of the felicities of our time, that little account is taken of the boundaries that separate states and kingdoms. The discoverer of a new law or principle in nature, of a new process in the arts or a new instrument of research, of beneficial tendency, is speedily heralded over land and ocean ; is welcomed as the benefactor of his race, and is immediately put into communication with the whole civilized world. We have before us a practical illustration of the amenities of science. We of the United States are here convened on British soil, little thinking that we have passed the boundary of the protection of American law, or that amidst the generous hospitality of this enterprising commercial capital of a noble Province of Great Britain, we are aliens to the British constitution. We have left the American eagle, but we assure the gentlemen of Canada that we feel in no danger of being harmed by the British lion. I have said that we are aliens to the British constitution ; but that must of course be taken in the narrowest and most technical sense, for I am proud to say, on deliberate conviction, that nothing is alien to the British Constitution that looks to the perfection of knowledge, to the furtherance of the arts or the amelioration of the condition of humanity. I further say, and (turning to Gen. Eyre) I here speak by permission, that the proudest achievements of British arms, and they have been proud enough for the highest desires of ambition or of glory, have been less glorious than that patronage of science, that success in the

arts, and those attempts to improve the condition of our race, which have placed Old England in the van of nations. At no period of time has that patronage been more wisely directed, or those noble efforts more earnestly persevered in than under the reign of the present illustrious Queen, whose virtues are alike the ornament of her sex and Crown. There is something of special fitness in our assembling here at this time—at a moment when England and America are shaking hands with each other across the broad bosom of the Atlantic, when that electric chain which is to bind them in perpetual friendship, is being placed securely in the depths of the ocean far out of reach of any temporary storms which may impair its repose or lessen its efficiency."

The Association was then welcomed to Canada, on behalf of the Province, the Local Committee, and the Natural History Society, in few but fitting words, by His Excellency the Administrator of the Government, Sir W. E. Logan, and Principal Dawson.

The division into sections is not so perfect in the American as in the British Association. The smaller number of scientific men and of papers, affords a reason for this; but we think that much more and better work could be done by a more minute sub-division. At the late meeting, after the primary division, established by the constitution, into sections of Physical and Natural science, but one sub-section was formed, that of Ethnology and Statistics. We shall take the matters presented to these sections in their order; dwelling especially, however, on the subjects more appropriate to the sphere of this publication.

SECTION OF PHYSICAL SCIENCE.

THE ZODIACAL LIGHT

Is a phenomenon interesting to the Naturalist as well as to the Physicist, and which like the Aurora Borealis, has formed a sort of stalking horse for makers of hypotheses. Commodore Wilkes, in a short paper, directed the attention of Section A to a very extended series of observations made by the officers of the United States Exploring Expedition, and more fully followed out, and represented in maps of the heavens, by the Japan expedition. The result of these observations is to suggest a very simple mode of accounting for this singular appearance. "When in command of the United States expeditions he had been especially directed to observe this light, and orders were accordingly given to

the officers of the watch to look out for the light, and when they saw it to call the commander and such other officers as took an interest in its observation. These gentlemen made diagrams of the appearance, which were handed to him for comparison, so that the results were not those of the observation of one but of many observers. At first few could distinguish this light, but after some time, they could readily point it out in its relation to the stars. In these observations he was much indebted to Mr. Dana. The first time of passing through the tropics, where the light is most visible, it was unfortunate that there was great obscurity of the atmosphere. This caused a want of means for comparison; but this deficiency had been supplied by some obtained from the Japan expedition. All the observations of the Zodiacal light showed that it had not changed its appearance since two centuries ago when first noticed by Cassini, and by observing it particularly, with reference to the great circles of the globe—ecliptic and equinoctial—it becomes manifest that all changes of its appearances depend on the position of the spectator on the surface of the *globe*. After mentioning the several theories which have been promulgated at different times to account for this phenomenon, he stated his opinion that none of them satisfactorily accounted for the observed facts. The drawings were made as the phenomena appeared to the eye, being projected therefore on vertical and horizontal lines. When the light first appeared it was generally as an arc near the horizon; but it rose in a few minutes from 30° to 80°. The light then began to spread, and show a diffused light, which gradually became more visible, till it was in its perfection at the moment when the arc obtained its highest altitude, and it became difficult to ascertain where the diffused light began and ended. At length it lessened in intensity and the whole gradually subsided. The apex of the light was always East or West of the Sun, usually about 90°, sometimes 100°. The evening and the morning zodiacal light did not agree in phase or azimuth. In fact it was plain that the cause of this light could not be far removed from the earth's atmosphere. Within the tropics, and when the ecliptic was perpendicular to the horizon, the zodiacal light was confined to a slender column, having its diffused light little extended. Without the tropics it was always inclined to the horizon. Corresponding observations made on the same day also showed an inclination in opposite directions, the two appearances of the light being inclined

towards each other. This showed that it was the same object seen from different positions, North or South of the ecliptic, and having its locality within the tropics. The Zodiacal light was not seen till the twilight ceased, but that gave only an indefinite idea of the time when it became visible at different places, because in the tropics there was little twilight. In northern latitudes the light had a greater altitude; but owing to the long twilights, was little visible, though it might be observed in the vernal and autumnal equinoxes even in this latitude. The light in the morning was not of the same colour as in the evening; in the first case being greyish, in the other having a reddish hue, depending on the approach or heat of the sun. After sunrise, he had seen it reach the zenith, with a breadth of only 2½ degrees. Sometimes the phenomenon was very beautiful, as if a gauze veil were spread over the atmosphere, through which the stars could be readily, though dimly seen. Thus the light stood alone and distinct from all others, its central line being parallel to the ecliptic, a little to the north or south of it, but sometimes corresponding with it. His idea of the origin of the light, from all these facts, was that it was the effect of the illumination of that portion of the earth's atmosphere on which the sun's rays fell in a perpendicular direction. To illustrate this, let it be remembered that if the sun's rays were admitted perpendicularly through a hole in the shutter, and all reflected light cut off, the atmosphere, or the particles floating in it, become plainly visible as well-defined objects."

On a subsequent day the same subject was brought forward by the Rev. M. Jones, U. S. N., who on the basis of a series of observations made by himself at Quito, maintained the conclusion that the Zodiacal light is a circle of nebulous matter not heliocentric, as heretofore supposed, but geocentric; in short if we understand the view correctly, that this mysterious appearance is an attendant on our planet, related to it as the well known rings are to Saturn. We are not in a position so to investigate the facts presented, as to accept either of these theories as final, but it is evident that Commodore Wilkes and Mr. Jones have collected facts that will bring us nearer to settled conclusions on the subject.

Passing over several papers of a more purely physical character, we reach a singular and elaborate series of papers by Mr. Gibbons, of the U. S. mint, on the

WEIGHTS AND MEASURES OF VARIOUS COUNTRIES.

These papers presented in a condensed form many curious

though well known facts, bearing on Ethnology and Natural History, of which the following may serve as specimens:

"He began by stating that about 1900 years ago, or about 52 years before the Christian Era, Julius Cæsar had described the inhabitants of Great Britain and Gaul, as making use of brass and iron rings by weight for money. Gold ring money of the Celts was also annually dug up in Ireland, and similar money was employed by the Scandinavians, on the shores of the Baltic. They were multiples of one certain ounce or integers of its proportions; the word for ounce being claimed as a purely Celtic one. Recently an ambassador wrote from Antwerp that he had purchased a gold chain of Rubens with the links stamped by the goldsmiths of the day to mark their weight and fineness. In South Africa, at the present day, there was a similar employment of metal rings. And a civilized country of antiquity, as appeared from paintings still remaining on walls, employed rings which were carried for cash to Ethiopia. Another nation had pieces of coin stamped with the likenesses of idols for the same purpose. The old pound of the Anglo-Saxons was called Easterling, from that came the modern sterling. In France there was a pound called the pound of Rochelle, and the Germans named it the pound of Cologne. A new system by which the pound of silver in tale was also made the pound in gross was arranged by Charlemagne, in the eighth century. In England, under William the Conqueror, it was decreed that weights, &c., should remain as they had been under his predecessors. In 1266, by consent of the whole Realm, it was determined that the silver penny, called esterling, should be round, and should be of the weight of 32 grains of wheat taken from the middle of the ear. Twenty of these penny weights were to make an ounce, 12 ounces one pound; 8 lbs. of silver a gallon of wine; and 8 gallons of wine a bushel, the eighth part of a quarter. Troy weight is supposed to have been derived from the Eastern nations, and transmitted first to Troyes, in France, from Cairo, during the crusades. From Troyes it was carried into England by the Goldsmiths, and found favor there under Henry 8th, who began to debase the standard fineness of silver coins, and to reduce their weight. Before this, a statute established a common standard by which silver and wheat were assumed to be the natural tests, the one of the other. Unfortunately, neither was exactly suited for the purpose. It had been found by experiment with white and red wheat from North Ca-

rolina—North Carolina flour having been reported the finest specimen at the great exhibition in London—that of red wheat 40 to 43 grains were required to balance a grain of silver, and from 28 to 35 or 36 grains of white wheat effected the same thing. In short, grains were not intended to serve as a just measure for perfect comparison, multiplication or division. Again, there was no such thing naturally as pure silver. It was produced only by art, and imperfectly reduced silver could not offer any just rule for the adjustment of weights and coinage. Attempts had been made to ascertain the purity of a silver penny of William the Conqueror, and it turned out there were in it 40-1000 of some base alloy. Now, in the U. S. Mint, at present, 3-1000 of alloy was all that was allowed for casual impurities. It was now never intended to make the metal perfectly pure; but whatever its purity, the rule adopted must be exactly followed out both with respect to the proportion of the precious metal and of the alloy. The old silver penny was a coin, a weight and a measure, and as its character of purity changed, the characters of all moneys, weights, and measures deduced from it were changed in the same proportion, for they did not depend upon the one element of weight or fineness; but on the products of both. The key stone was a penny sterling; but an error in this key stone made the whole arch fall, because the metallurgical inaccuracy was not checked by any metrical exactness. The bases being inaccurate no truth could be elicited from calculations founded upon them."

Troy weight being thus illustrated, the following remarks were made on the carat weights of the East:—"Among Eastern nations carat grains were used to determine the weight of Pearls and precious stones. Originally a bean, the Karat, was thought when dry to vary very little in weight. A natural section divides this bean into halves, which are again cut into quarters and are again divided, the smaller divisions being used to mark the different degrees of fineness of gold and silver The Chinese use a peculiar kind of pea and grains of maize and Indian corn. In Sumatra grains of rice are used. Thus a gardener's trade basket seems to have afforded all the standards required, and all the weights wanted by our ancestors, until nearly the close of the last century. The author then went on to show by the result of various trials the great discrepancy really existing between these original standards of weight, some grains weighing twice as much as others. Hebrew writers say that the barley corn was an

element in the valuation of the shekel. The chemists of the middle ages used nitric acid and muriatic in preparing the precious metals, and in earlier times they had what is called the dry process, which is described by Hebrew writers with great minuteness. In South America the Eastern methods prevail, and it is a remarkable circumstance that a pilot in Pizarro's expedition observed, in one of the native vessels, a scale for weighing gold similar to what he had been accustomed to see in his own country. The principle of procedure in preparing gold has in all ages been the same, although the practice has differed. In the second chapter of the Book of Genesis, the different qualities of gold are spoken of, and through these records of antiquity examples are given, similar to the modern process, of melting, casting, graving and stamping metals. From these facts he concluded that very great progress in the arts and sciences must have been made at the time when these books were written."

Lastly, the avoirdupois weight, according to Mr. Gibbons, can claim a very remote antiquity, and is also based upon the weights of seeds:—" This kind of weight, which he stated to have been fixed in various countries by an arbitrary rule, was anciently called Poids de Marc, and was designed for weighable articles —" Choses Poisibles" and to be used for current market purposes. It had its origin in Babylon, " a city of Merchants," and was carried to Atlantic Spain by colonists from Tyre about 3056 years ago. Spain produced a large amount of gold, and the Royal mint was noted for the purity of its coin, but in the 14th century no less than 150 mints were licensed, so that the coin became so debased that all trade was carried on by barter. At an early period it was said that there was a mint in nearly every county in Great Britain. In ancient times it is supposed that an affinity existed among the weights and monies of the various nations similar to that now existing among modern nations. Thus the average weight of a shekel, a coin of current money, is described as being half an ounce avoirdupois in refined silver, and by Hebrew tradition it weighed 320 common barley corns ; and proof of an understood standard of current money in very ancient times is given in the sale of several instances in the sacred writings ; as in the sale of Joseph by his brethren ; the purchase of a burying ground by Abraham, which was evidently " a cash transaction," the payment being made in metallic silver, current money among the merchants ; and the payment of his fare in a Spanish vessel

by Jonah—all showing that there was a well understood standard, and it is supposed that this standard was computed by the avoirdupois weight. The avoirdupois weight is supposed not to have been introduced into England from Europe until 1335. Mr. Gibbon then went on to speak of the standards of value established at different times in the U. S. and British mints, stating that the coin had a somewhat depreciated value, established by an arbitrary rule adopted for the purpose of convenience, as compared with the original standard in Spain. According to the present value of the ounce avoirdupois, the shekel would be worth 63 cents, or about an English half-crown. He then spoke of the origin of the word dollar, which he derived from the Greek word for image, the word coin being attributed to a similar derivation. This derivation arose from the fact of coins being issued from the temples, the image stamped upon them being a guarantee of the purity and due weight of the coin. Mr. Gibbon then made some remarks upon the relative value of gold and silver, 16 ounces of silver being equal to 1 of gold. He then went on to speak of the certainty, drawn from observations already stated, that a regular coinage must have existed in very early times, and of the fact that some ancient process of mintage must have existed of a simple and inexpensive nature, as it is known that wherever there was a Greek colony there was a Greek coinage. A comparison between the present process and that of the past induces a conviction that the same means were adopted before the days of Moses which were afterwards contrived by Sir Isaac Newton, Master of the British mint during the reign of George the 1st. The following quotation from Deuteronomy, chap. 25, v. 15, is the conclusion of the paper : " Thou shalt have a perfect and a just weight, and a perfect and a just measure shalt thou have, that thy days may be lengthened in the land which the Lord, thy God, giveth thee."

Our old nursery idea that fire will not burn well in sunlight, was overthrown by Prof. Le Conte, in a paper on

SOLAR INFLUENCE ON COMBUSTION.

"He gave a sketch of various experiments tried by other scientific men with regard to this subject. He then explained the experiments by which he had endeavoured to ascertain whether the influence of Solar light on combustion was such as had been indicated by previous experiments, especially those of Dr. McKeever. The result of his experiments was a negative one

the difference between the rapidity of combustion in the light and in darkness being extremely small, and sometimes in favor of the light and sometimes in favor of the dark, while the difference between them on different days sometimes amounted to 9 per cent. This fact he held to be a proo. that the former theory had been too rashly generalised from isolated facts, and he came in general to the conclusion that the observed influences upon the rate of combustion were due to the state of the atmosphere, and not to any Solar action. Following up this conclusion, and guided by a large number of well authenticated and carefully observed experiments carried on under various circumstances, the deduction drawn was that combustion was retarded by rarifiaction and accelerated by condensation. He then detailed a number of observations by which it was found that the ratio of combustion was greater than the ratio of density. One great result of all these observations and experiments was that there is an immense number of atmospheric influences, the effect of which have as yet been undiscovered. There were, however, two conclusions which he believed to be established. First, that *Solar light* does *not* seem to exercise any sensible effect upon combustion ; and secondly, that variations in the *density of the air do exert* a striking effect in retarding or accelerating the rapidity of the process—the rate of burning augmenting with every increment of density, and *vice versa.*"

Prof. Olmstead of Yale College, communicated an interesting paper on

THE AURORA BOREALIS,

in which he criticised the Electric theories of this phenomenon :—"The Professor commenced by a reference to a paper which he had previously written on this subject, and which was published among the contributions to the Smithsonian Institute. In this paper he had recorded a number of facts derived from a series of observations upon the very strickingly magnificent Auroras which had been witnessed during a period of about twenty years, commencing about the year 1837. The theory which he had deduced from these facts was, that contrary to the general hypothesis which ascribes the Aurora to Terrestrial sources, its origin was cosmical, the matter being derived from the planetary spaces.—His arguments in favor of this theory, in opposition to the electrical hypothesis, were based upon the immense extent of the phenomena beyond the reach of atmo-

pheric excitations ; secondly, from their occurring at the same hour of the night in places very far distant from each other ; thirdly, from the velocity of their motions ; and fourthly from the periodicity of their occurrence during a certain time, and then disappearing altogether from the heavens. With regard to their having a revolution round the sun, he thought that to be affected by the question of zodiacal light, with which he thought they had some connection ; and if it should appear that the Zodiacal Light was a ring round the earth it would not affect this conclusion. He had previously stated that the long series of brillant Auroras which had been recently witnessed would soon be over and not appear again until after a period of about forty years ; the regular period being calculated at sixty years. He would ask members of the Association to remark that for five or six years past the brilliancy of the Aurora had diminished, and he would ask those who could not look back to 1837 and 1840 when the maximum brightness of the Aurora was observed, not to consider the appearances now seen as comparable to those exhibitions which the older members could remember. He would ask them only to consider as the Aurora those immense banks of light which, in 1835 and 1837 used to appear in the North West, rising into columns of a scarlet or blood-red colour, with spindles moving to the South East, and arranging themselves in a magnificent crown round the zenith ; while the whole heavens were suffused with crimson light. For five or six years no such exhibition had occurred. In 1840 there were 75 strikingly magnificent exhibitions of the Aurora, while for several years they had scarcely seen one. After the discovery of the analogy between electricity and lightning, it became the practice to ascribe everything to electricity. No one could doubt that electricity holds a high place among the ultimate causes of natural phenomena ; he only objected to ascribing everything to that agency without even first proving its presence. This practice had damped enquiry into many phenomena, and among others, into those relating to the Aurora Borealis, and it was always deemed sufficient to say that the Aurora was an electrical phenomena. Various arguments were urged in favour of the electrical hypothesis, and upon them he would remark that the resemblances between electricity and the Aurora had been greatly overstated. Fire, the sun, a lamp, or a star have all some resemblance to the Aurora, but from his own observation he was compelled to say that the likeness was very

faint, both with regard to the shape of the light and its motions. The reasoning was this. Lightning was known to be the discharge of electric clouds, and because the Aurora was said to be like the flash of lightning, it was supposed to be discharge of electric clouds in the higher strata of the atmosphere. This rested on very small foundations ; for instance, the same Aurora had been known to be visible from the extreme point of Asia to the coast of California. Electricity would not account for this. As for the shape and form of the phenomena they might be accounted for by various means as well as by electricity. From the foregoing considerations he was led to conclude that any argument founded upon the resemblance between electricity and the Aurora was inconclusive and unsatisfactory. The defenders of this hypothesis had not agreed in anything but that the Aurora was in *some way or other* connected with electricity, but they disagree as to the mode in which it is done. The Professor then went on to discuss the various theories that had been advanced by different writers upon the cause of the Aurora, and in commenting upon them he begged to call attention to the real question, which was this—What is the origin of the Aurora Borealis ? Is the matter which composes it derived from the earth in any way, or does it come down from the planetary spaces ? If the Zodiacal Light is a ring round the earth and affords material for meteoric stones, much more fully might it be concluded that the Aurora is ferruginous, and that would help them to explain the hypothesis that the Aurora is magnetic. No doubt, electricity might present some of the appearances of the Aurora, but it was not sufficient to account for them all. The motions of the Aurora were progressive and not instantaneous, as was the case with electric flashes. Moreover the periodicity of the Aurora was not accounted for by the electric hypothesis. By another hypothesis the Aurora was ascribed to magnetism. It must be admitted that there is some connection between the two, as is shown in various ways, but these facts merely prove that it has magnetic qualities—they prove nothing as to its origin. The material of which it is composed and its extent, are not accounted for by any of these hypotheses, while they are satisfactorily accounted for by assigning it to a cosmical origin."

The great tides of certain bays and Estuaries are of much interest to the geologist, and from a paper contributed by Prof. Bache

ON THE HEIGHT OF TIDES ON THE ATLANTIC COAST,

it appears that the causes producing the seunusual tides are much

more extensively distributed than hitherto supposed:—"It was well known that when the tide flowed into any bay whose mouth was favorably placed for the reception of the tide wave flowing in, the height of the tide increased as it advanced towards the head of the bay. Extended observations went to show that the same phenomenon was observable in the greater divisions of the coast. He divided the Atlantic coast into three great parts, which he called the great southern, great middle and great eastern bays. The first extended from Cape Florida to Cape Hatteras, the second from Cape Hatteras to Cape Cod, the third thence to Cape Sable and perchance to Cape Race. His own observations extended as far north as Cape Ann, and he had been assisted in making up the results by Mr. Portalis. The tidal observations for New Brunswick and Nova Scotia (including Cape Breton), and part of Newfoundland, were obtained from Captain Shortland and Admiral Bayfield of the Royal Navy, whom he desired thus publicly to thank for their kindness. He should make no farther use of the information they had communicated to him than as helping out the illustration of his theory of the rest of the coast of North America, leaving them to bring before the public and reap the honor of their own investigations. Pursuing his subject, he showed that at the southern headland of the southern bay, Cape Florida, the mean tide was 1-10th foot; at Cape Hatteras, the northern headland 2 feet; while at Savannah, at the bottom of the bay, it rose to 6 feet, and it was found that the tidal lines between these points corresponded with the lines of the coast. At Cape Hatteras, again, and Cape Cod on Nantucket, the tides were the same, (2), while at New York, the bottom of this bay, they rose to 7. At Nantucket the transition from the regime of the middle to the eastern bay was sudden, and they had within a few miles five co-tidal lines touching the coast, which elsewhere were widely apart. From Cape Cod to Cape Ann, at the bottom of the great eastern bay, there was a rise of from 2 to 8 or 9, diminishing again at Cape Sable to 6, but he had reason to believe that this bay really extended to Cape Race. He next proceeded to notice the several bays and inlets along the coast, which generally showed the same characteristics in a more marked manner. In the Bay of Fundy, for instance, the height of the tides increased from Portland to Grand Manan from 8 or 9 to 17, and thence to the bottom of the bay to 36. Prof. Bache's paper was illustrated with some very interesting diagrams and charts, shewing the wonderful coincidence of

the height of the tides in various places, with the lines of the coast."

Prof. Henry read a paper on

SOME PHENOMENA OF ICE.

"He said that they were in the habit of receiving all sorts of communications and curiosities at the Smithsonian Institution; and more questions were put them than many very wise men could hope to answer. One cold day in winter, a countryman was shown into his office, who said he had travelled 20 miles to bring him a curiosity. He proceeded to unpack it, and instead of an animal, as he had expected, he found it to be a milkpan filled with frozen water. On the top of the ice in it was a strange formation, created without apparent cause. A crystal of ice protruded from it in a slightly oblique manner, in shape almost like an isosceles triangle, with its sides somewhat curved. This crystal was found to be hollow. After ordering a drawing to be made of it, the matter was laid aside for subsequent consideration, and not again taken up until questions were subsequently put to him respecting the cracking of ice in very cold weather. It was well known that in the process of the solidification of melted metals, and the freezing of water, the crystals are produced in the direction of the surface from which the heat escapes. In the freezing of the water in a vessel of this sort, the crystals run in nearly horizontal lines, crossing each other at an angle of 60 degrees. The water, freezing first from the sides and bottom of the vessel, left in the centre and top a triangular space, which the yet unfrozen but expanding water found too small for it. It rose above the level of the ice, therefore; its edges freezing there again, the same phenomenon recurred, and the crystal was built up. Ice having once been formed, however, followed the law of all other bodies, contracting with cold and expanding with heat. Thus it was that in very cold weather the ice was found to crack open sometimes with a loud report, the cracks taking place in the parts of least resistance, generally the narrowest portion of the body of water frozen over. The crystals formed on the surface of large bodies of water in the process of freezing were nearly perpendicular, the cooling surface being that exposed to the cold winds. This was easily seen as the ice decayed, and the crystals separated the one from the other. The subsequent expansion of the ice by the recurrence of warm weather sometimes brought the edges of the fissures together, and crushed the newly-formed ice into a heap or

mound. This same effect upon frozen earth had caused in some places during the past winter the cracking of the ground with loud reports, which had alarmed people in the vicinity."

Some discussion ensued as to the hollowness of the crystal which did not seem satisfactorily accounted for. It was suggested, however, that the enclosed water must have found means of escape ere the solidification was complete.

We close our brief and imperfect notice of the Physical section. with two papers by Prof. Smallwood. One of these related to that mysterious substance, or probably modification of the oxygen of the atmosphere, OZONE. The other was an interesting account of the METEOROLOGY OF MONTREAL AND ITS VICINITY These papers we do not at present notice more at length, as we hope to have the papers themselves for publication.

SECTION OF NATURAL HISTORY AND GEOLOGY.

The first paper in this section, by Mr. Snell, described some processes for the quantitative assay of chromium by the blowpipe. The next was that on *Sternbergia*, by Prof. Dawson, which we publish in the present number. Mr. Lesley then read a description of some curious *Flexures of the strata*, in the Broad-top coal field of Pennsylvania, which he attributed to enormous lateral pressure acting on soft beds, compressed between sheets of inflexible sandstone. The results, as exhibited by Mr. Lesley, from actual measurements, are very singular, and most perplexing to the miner and geological observer.

Sir W. E. Logan then read a paper explanatory of the destinction between the great series of ancient metamorphic rocks which he had named respectively the

HURONIAN AND LAURENTIAN SERIES OF CANADA.

"The sub-silurian azoic rocks of Canada occupy an area of nearly a-quarter of a million of square miles. Independent of their stratification, the parallelism that can be shown to exist between their lithological character and that of metamorphic rocks of a later age, leaves no doubt in my mind that they are a series of very ancient sedimentary deposits in an altered condition. The further they are investigated, the greater is the evidence that they must be of very great thickness, and the more strongly is the conviction forced upon me that they are capable of division into

stratigraphical groups, the superposition of which will be ultimately demonstrated; while the volume each will be found to possess, and the importance of the economic materials by which some of them will be characterised, will render it proper and convenient that they should be recognized by distinct names, and represented by different colors on the geological map. So early as the year 1845, as will be found by my report on the Ottawa district (presented to the Canadian Government the subsequent year), a division was drawn between that portion which consists of gneiss and its subordinate masses, and that portion consisting of gneiss interstratified with important bands of crystalline limestone. I was disposed to place the lime-bearing series above the uncalcareous, and although no reason has since been found to contradict this arrangement, nothing has been discovered especially to confirm it: while the complication which subsequent experience has shewn to exist in the folds of the whole, (apparent dips being from frequent overturns, of little value,) would induce me to suspend any very positive assertion in respect to their relative super-position, until more extended examination has furnished better evidence. In the same report is mentioned among the azoic rocks, a formation occurring on Lake Temiscaming, and consisting of silicious slates and slate comglomerates, overlaid by pale sea-green and slightly greenish-white sandstone with quartzose conglomerates. The slate conglomerates are described as holding pebbles and boulders (sometimes one foot in diameter,) derived from the subjacent gneiss, the boulders displaying red feldspar, translucent quartz, green hornblende and black mica, arranged in parallel layers, which present deflections, according with the attitude in which the boulders were accidentally enclosed. From this it is evident that the slate conglomerate was not deposited until the subjacent formation had been converted into gneiss, and very probably greatly disturbed, for while the dip of the gneiss, up to the immediate vicinity of the slate conglomerate, was usually at high angles, that of the latter did not exceed nine degrees, and the sandstone above it was nearly horizontal. In the report transmitted to the Canadian Government in 1848, on the North Shore of Lake Huron, similar rocks are described as constituting the group which is rendered of such economic importance from its association with copper lodes. This group consists of the same silicious slate and slate conglomerate, holding pebbles of syenite instead of gneiss, similar sandstones, some of them tinged green, and similar quart-

zose conglomerates, in which blood-red jasper pebbles become largely mingled with those of white quartz, and in great mountain masses predominate over them. But the series is here much intersected and interstratified with greenstone trap, which was not observed on lake Temiscaming.

These rocks were traced along the north shore of Lake Huron, from the vicinity of Sault Ste. Marie for 120 miles, and Mr. Murray ascertained that their limit on the Lake Shore occurred near Shibahahnahning, where they were succeeded by the underlying group. The position in which the group was met with on Lake Temiscaming is 130 miles to the north east of Shibahahnahning, and last year Mr. Murray, in exploring the White Fish River, was enabled to trace the out-crop of the group characterized by slates, sandstones, conglomerates, greenstones, and copper-lodes for sixty five miles from Shibahahnahning to the junction of the Maskinongé and Sturgeon rivers, tributary to Lake Nipissing. The general bearing of the out-crop is N. E., and an equal additional distance in the same direction, would strike the exposure on Lake Temiscaming. In the portion which Mr. Murray examined last year, the dip appears to be about N. W., often at a high angle, while that of the subjacent gneiss is more generally S. E., sometimes at a low angle, and in some places nearly horizontal. To the eastward of this out-crop, Canada has an area of 200,000 square miles; this has yet been but imperfectly examined, but in so far as investigation has proceeded, no similar series of rocks has been met with in it; and it may safely be asserted that none exists between the basset of the Lower Silurian and the gneiss, from Shibahahnahning to the Mingan Islands, a distance of more than1,000 miles, and probably still farther to Labrador. The group on Lake Huron we have computed to be about 10,000 feet thick, and from its volume, its distinct lithological character, its clearly marked date, posterior to the gneiss, and its economic importance as a copper-bearing formation, it appears to me to require a distinct appellation and a separate color on the map; without which, indeed, the investigation of Canadian geology could not be conveniently carried on. We have in consequence given to the series the title of Huronian. A distinctive name being given to this portion of the Azoic rocks renders it necessary to apply one to the remaining portion. The only local one that would be appropriate in Canada, is that derived from the Laurentide range of mountains, which is composed of it from Lake Huron to Labrador. We have therefore, designated it

as the Laurentian series. These local names are, of course, only provisional, devised for the purpose of avoiding periphrastic or descriptive titles, the use of which has been found inconvenient; and they can be changed when more important developements, proved to be the equivalents of the series, are met with elsewhere.

In answer to a question whether these Huronian Rocks were older than the Silurian, or whether there was any indication of their being Silurian metamorphosed; Sir William said the Huronian rocks lie unconformably under the Silurian, and that the lower beds of the Silurian in contact with the Huronian are made up of its ruins. They found the Huronian in nearly a vertical attitude, but there is no possibility of doubt as to the comparative age of the Huronian and Silurian rocks."

ORIGIN OF MAGNESIAN ROCKS.

Mr. T. Sterry Hunt then read a very interesting paper on Mineral Waters and on the origin of Magnesian Rocks. "He alluded first to the deposits of mineral springs and especially of calcareous waters, as having played an important part in the formation of rocks. The deposits of such waters are however generally destitute of carbonate of magnesia, which is held in solution by them, and only precipitated on evaporation. Carbonate of soda is very abundantly distributed in certain mineral waters, and these mingling with sea-water, or with mineral waters analogous to it in their nature, have at first the effect of eliminating the lime as a carbonate, leaving the greater part of the magnesia in solution, ready to be precipitated in part by evaporation, or more completely by the farther addition of carbonate of soda. In this way dolomites may be deposited in the open sea, and may form, as they often do, the cementing material of conglomerate or coralline limestones. They may be equally formed by the evaporation in limited basins or lagoons, of waters holding carbonate of magnesia dissolved in the manner above described; in the latter case, we can easily understand the precipitation of magnesian carbonate unmixed with lime. The interstratification of dolomites with pure limestones in the Silurian rocks of Canada, was described as irreconcilable with the hitherto received theories of the origin of dolomites, and it was maintained that the hypothesis now proposed, is the only one which meets the conditions of the problem."

SUBSIDENCE OF LANDS.

Professor G. H. Cook, of Rutger's College, then read a paper on the subsidence of the land on the sea coast of New Jersey and

the adjoining States. "Mr. Cook said that in the course of some geological examinations near the coast of Southern New Jersey, his attention was frequently called to various facts indicating a change in the relative level of the land and water at some recent period. An attentive examination of these facts led him to the conclusion that a gradual subsidence of the land was now in progress throughout the whole length of New Jersey and of Long Island; and from information derived from others, he was induced to think that this subsidence might extend along a considerable portion of the Atlantic coast of the United States. The occurrence of timber in the marshes and water below tide-level was common along their whole Atlantic shore. Almost every one familiar with shore-life had observed the remains of logs, stumps, and roots in such places, although they had been looked upon generally as the remains of trees torn from their original place of growth by torrents, or by the necessary moving of the shores, and deposited in the places where they were found by the ordinary action of the water. But close examination made it evident that they grew upon the spots where they are found. The stumps remain upright—their roots are still fast in the firm loamy ground which underlies the marsh, and their bark and small roots remain attached to them. The localities in which they are most abundant are such as are least liable to be affected by the violent action of the water or of storms. Thus they are by far the most abundant on the low and gently sloping shores of Long Island, New Jersey, and all the States farther South which are protected from the violent action of the surf by a line of sand beaches, at the same time that the numerous inlets allow free access to the tides. In these protected situations hundreds and even thousands of acres can be found in which the bottom of the marshes and bays is as thickly set with the stumps of trees as is the ground of any living forest. His own observations were chiefly made upon the southern part of New Jersey, following the shores of Delaware Bay from its head down to Cape May, and the Atlantic shore from Cape May north to Great Egg Harbor, and thence eastward at several points along the south shore of Long Island. In the ditches in the marshes, above Salem, great numbers of the stumps and trunks of trees are met with at all depths, quite down to the solid ground. At Elsinboro' Point, a little farther down on the Delaware Bay shore, the cutting away of the marsh by the water has left great numbers of stumps exposed, where they can be seen at every low

tide still firmly rooted in the hard ground. In the bank of Alloway's Creek, a few miles below, the remains of trees can be seen under the same circumstances. They are also common in all the marshes of Cumberland County, and great numbers of them can be seen in the marshes on Maine River, at Dorchester and below. In Cape May County they are seen everywhere in the marshes and the creeks, on the Delaware Bay; on the inside of Seven Mile Beach, on the sea side; and below Luckahoe, on Great Egg Harbour. In the marsh on the Raritan, above South Amboy, hundreds of them were dug out in cutting a canal across a bend in South River. The marshes on Staten Island also contain buried timber; and on Long Island, at Hempstead, at Babylon, and still further east, the same fact is of constant occurrence. At several places in Southern New Jersey an enormous quantity of white cedar timber is found buried in the salt marshes—sound and fit for use, and a considerable business is carried on in mining this timber and splitting it into shingles for market. At Dennisville there is a large tract of marsh underlaid by cedar swamp, earth and timber. By probing the marsh with an iron rod, the workmen find where the solid timber lies, and then removing the surface sods and roots, they manage to work in the mud and water with long one-handed saws and cut off the logs, which then rise and float, as the timber is not water-logged at all, but retains its buoyancy, and the removal of that nearest the surface releases that which is below and it rises in turn, so that a new supply is constantly coming up to the workmen. In this way a single piece of swamp which is below tide-level has been worked for fifty years past, and still gives profitable returns.

Prof. Cook here referred at considerable length to the opinions of various parties who had been making similar examinations to those detailed, showing by reference to a map the various positions in which they had been made, and also quoted several authorities as to the fact of land having been submerged within a recent period. The owner of an extensive tract of land, between Maurice River and West Creek, informed him that within the last fifty years he had lost 1,000 acres of timber by the tides running higher on the upland than they formerly did. On West Creek he was shown portions of upland on which good crops of wheat had been raised, within thirty years, which was now liable to be overrun by the tides. The same farm has, within the the last fifty years, lost 50 acres—part wood and part cultivated

land—in the same way. After quoting the published opinions of Professor Hitchcock, Professor Dawson and others, Professor Cook said—After examining all he had been able to find written, he could find no other theory which would embrace all the facts, than that of a slow and continued subsidence of the ground. In regard to the rate at which this subsidence was going on, the Professor quoted the result of several examinations, and said with these several results—three of a subsidence of 3 feet in 150 years, one of two feet in 100 years, two of 1 foot in fifty years,—and one of 4 inches and one of 8 inches in 2 years, he might, with some degree of probability, set the average subsidence in the district where the observations were made, at two feet in a century. The opportunities for accurate observation was less frequent in several of the places mentioned than in the southern part of New England; but from the phenomena of the marshes and of the submerged forests of Long Island and in northern New Jersey, he inferred that there was no material difference in the rate from that already deduced."

METAMORPHISM OF SEDIMENTARY ROCKS.

A subject of commanding importance in chemical geology, is the METAMORPHISM OF SEDIMENTARY ROCKS; but hitherto chemists have regarded it as a difficult and uninviting field. We are glad to find that Mr. Hunt, of the Canadian Survey, has been cultivating it with marked success. His paper on this subject was replete with suggestive facts and inferences; much more so than can be gathered from the following somewhat meagre abstract.

"The fact which forms the point of departure for the history of the metamorphic rocks is this:—That the sedimentary strata common to different geological formations, may under certain conditions, be converted into crystalline rocks. One of the most important results of modern geological research has been to show that the crystalline schists of various regions are stratigraphically identical with unaltered sediments of Silurian, Devonian, and even of later secondary age, although regarded as primitive rocks by the geologists of the last generation. Mr. Hunt observed that we have besides those sedimentary rocks of mechanical origin, which are composed of the ruins of felspathic and quartzose rocks, others of organic origin, and finally deposits of limestone, dolomite, magnesite, carbonates and oxyd of iron, and manganese. These chemical deposits are often mingled with those of mechanical origin. He contended that a dry heat, producing fusion of the sediments, cannot be

admitted to explain the changes which they have been found to have undergone, from the fact that such a temperature was incompatible with the existence of alkaline silicates and of graphite in the limestone. The influence of hot water alone is equally inadmissible, for the silica being dissolved by water before it could act upon the bases, we should find the quartzites rendered vitreous and crystalline.

He regards the changes as having been produced by the action of small amounts of carbonate of soda in aqueous solution forming with the quartz, silicate of soda, which is afterwards decomposed by the earthy carbonates; yielding silicates of these bases, and reproducing the carbonate of soda. A portion of the alkali is, however, always fixed and rendered insoluble in the process, so that with a limited portion of soda, the action is at last exhausted. These reactions, resulting in the production of silicates of lime, magnesia, &c., take place even at 212° F, and the intervention of alumina gives rise to garnet, chlorite and epidote. The absence of iron from some felspathic and quartzose sediments, and its accumulation as beds of iron ore, he regards as effected by the agency of organic matters, which reduce the iron to protoxyd and render it soluble in water, which afterwards deposits it as oxyd or carbonate. The same process produced the fire-clays and ironstones of the coal period, and is now operating in bogs and marshes. In this way we have beds of argillaceous and felspathic materials freed from iron.

CRYSTALLINE ROCKS OF THE NORTH HIGHLANDS OF SCOTLAND.

We give in full a paper on this very interesting subject, communicated by Sir R. Murchison and Mr. Salter. It brings within the limits of the recognised subdivisions of the Silurian System in Britain and America, a group of metamorphosed rocks, hitherto of uncertain age.

London, July 27, 1857.

My Dear Sir William,—Being unable, to my great regret, to attend the Montreal Meeting of the American Association for the Advancement of Science, where my distinguished friend Professor Ramsay, will represent British Geologists and our Survey, I beg to communicate to you, and any geological contemporaries who may be present, the final determination of a question which has been much agitated in this country, and which has just been settled by a comparison with North American typical fossils of Lower Silurian age. This question is: what is the true place in

the geological series, of those great masses of crystalline or sub-crystalline stratified rocks, in the North Highlands of Scotland, in some of which organic remains were discovered by Mr. Charles Peach, in 1855?

That discovery induced me, in the same year, to re-visit the localities in the north-west part of Sutherlandshire, to the east of Cape Wrath(Durness), in which the fossils had been detected; my chief object being to ascertain if the views of former explorers of that region, including Sedgwick and myself, in 1827, were correct; viz., that these quartz rocks and limestones, associated with mica schist and a sort of gneiss, are of a more ancient date than the great series of Old Red Sandstone, or Devonian deposits, that occupy so large a portion of the north-east of Scotland, and are particularly developed in Caithness and the Orkney Islands.

The results arrived at in that excursion, in which I was accompanied by Prof. James Nicol, were communicated at the meeting of the British Association at Glasgow, in September, 1855, and published in the volume of that year—(See Transactions of the Sections, 1855, p. 85). I then re-affirmed the opinions I had formed in the year 1827, in company with Professor Sedgwick, as to the anteriority of all these quartz rocks with intercalated limestones, to the Old Red Sandstone, or Devonian System; and judging from the facts that such crystalline and sub-crystalline strata reposed unconformably upon an ancient granitoidal gneiss, and were flanked and surmounted by the ichthyolitic deposits of Caithness, I expressed my belief that, although very imperfect and difficult of absolute determination, the fossils there found by Mr. Peach were of Lower Silurian age.

At that time, my eminent and lamented friend, the late Hugh Miller, had suggested theoretically that the quartzites and limestones of the North Western Highlands might prove to be the metamorphosed equivalents of the Old Red series of the East Coast; and, subsequently, Prof. Nicol has even endeavored to show that these rocks may be the metamorphosed representatives of the carboniferous series of the South of Scotland! Both these suggestions were of course opposed to my own belief, and as they have been put forth by distinguished contemporaries, I have now to show how my own views have been sustained.

Within these few weeks, Mr. C. Peach has found, in the same locality, (Durness), other and better preserved fossils, which have, I rejoice to say, set the *questio vexata* at rest, as will be seen by

the annexed note of Mr. Salter, who unhesitatingly compares these remains with those known to Mr. James Hall, yourself, and other North American Geologists, as occupying the true Silurian position of the calciferous sandrock and base of the Trenton Limestones.

It is of course most gratifying to me to find that the general views of succession of the rocks of my native Highlands, indicated so far back as the years 1826-7,—opinions then formed irrespectively of zoological evidences, and simply from the physical relations of the rock masses, should have been thus supported by fossil discoveries.

North American geologists will, of course, have no difficulty in understanding and admitting the conversion of Lower Silurian sediments into quartz rocks, crystalline limestones, mica-schists, chloritic slates, &c.; since their own eastern coast ranges exhibit such phenomena, some of which have been described and mapped by yourself.

To the geologists of the old country this determination is of the deepest interest; for it gives them a key to unravel the real age of large masses of the quartzites, limestones, chloritic and clay slates, mica-schists and quasi-gneissic rocks (sometimes more sometimes less metamorphosed) which occupy vast wild tracts of the Highlands of Scotland.

The general order of the Scottish rocks is, therefore, pretty well ascertained. The lowest known rocks are masses of granitoid gneiss, on the upturned edges of which repose certain hard gritty beds, and conglomerates, often of a red colour, which, in the early days of our science, were confounded with the Old Red Sandstone. Now, however, that the existence of conglomerates at different levels in the Lower Silurian rocks of the south of Scotland has been demonstrated, (See Siluria, p. p. 156-160,) the old views dependent on the mineral characters only, have been swept away. The lowest, indeed, of the conglomerates on the northwest coast of the Highlands may pass for the Cam brian Rocks of the Geological Survey. Then follows in an ascending order, the series of quartzites, mica and chloritic schists, &c., with included limestones, representing in a metamorphic condition the Lower Silurian sediments.

It is highly probable that the Upper Silurian rocks which exist partially in the south of Scotland, have no real equivalent in the Highlands; since the metamorphic rocks above adverted to,

are unconformably overlapped by those conglomerates and sandstones which form the very base of the Devonian rocks or Old Red Sandstone.

That great series is clearly exhibited on the north east coast of the Highlands, and is made up of three subdivisions; viz., (a) Lower Conglomerates and Sandstone, (b) Middle Flagstones and Schists, with abundance of the well known ichthyolites, and (c) Overlying Sandstones—the latter constituting the northern headlands of Caithness, and the chief hills of the Orkney Islands.

I feel confident that this triple series represents in full, as I have endeavored to show in my work, Siluria, the Devonian rocks of Devonshire, as well as the slaty rocks of the Rhenish Provinces (including the Terrain Rhénan of Dumont.)

The *experimentum crucis* as respects Russia, was in fact settled by the discoveries of my colleagues De Verneuil, and Keyserling and myself, when we found the fossil shells of Devonshire and of the gorges of the Rhine, in the same beds with the ichthyolites of the Scottish Old Red; many species being identical.

In turning to Ireland we have there obtained evidences illustrative of the conversion of Lower Silurian rocks, as shown by sections across the Connemarra Mountains, where a great succession of crystalline limestone and quartzites, including the green Connemarra Marble, having been observed to lie directly beneath strata with fossils of the Llandovery Rocks (Middle Silurian), I have had no hesitation in considering these altered masses to be representatives of the Lower Silurian of other tracts. (See Siluria p. 108.)*

Again adverting to Ireland, the Survey under our friend Mr. Beete Jukes has ascertained, that in the Dingle Promontory true Upper Silurian Rocks, with both Wenlock and Ludlow fossils are conformably surmounted by many thousand feet of hard chloritic and silicious grits and schists (Glengariff grits), which represent in my opinion the great mass of the Devonian Rocks. The peculiarity, however, of the Irish section is that between these Glengariff Grits, and that which has hitherto been exclusively called the Old Red Sandstone of Ireland, there is a great hiatus; for the latter reposes on the edges of the former, and passes conformably under the carboniferous deposits.

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* Note.—I examined this tract last year in company with Mr. Jukes, Mr. Griffith and Mr. Salter. Mr. Du Noyer has ably mapped and delineated the country.

This phenomenon, however, simply shows that a great break or local change in the sediments, took place in the S. W. of Ireland which had no existence in the north east of Scotland, where the Old Red or Devonian series is continuous.

I cannot on this occasion enter into questions of detail concerning the localities where the Upper Silurian strata pass upwards with perfect conformity into the Old Red or Devonian rocks,) or indicate other tracts in Europe (notably in France and Spain) where on the contrary the Upper Silurian is entirely omitted. In regard to local dislocations, I particularly refer you to my comparison of the Old Rocks of the Thuringerwald and the Hartz.* I will simply conclude this letter by calling your attention to what is now seen to be the true method of comparing the Older Palæozoic or Silurian Rocks of distant regions.

When that skilful and profound geologist, Mr. Barrande, published in the course of last year his most instructive essay, entitled "Parallèle entre les dépôts siluriens de Bohême et de Scandinavie," he showed how with an agreement in generic characters of the fossils of each Silurian zone, thus indicating a general harmony, there was a great contrast in the species of marine animals in each of the countries compared. By applying this method in a different sense, I may now say that when the Silurian rocks are viewed in their extension through the same latitudes, a remarkable specific agreement is clearly traceable. On the other hand the Silurian fossils of Bohemia are in accordance with those of France and Spain, or along another and distinct broad southern zone of the same age.

The Silurians of Scandinavia are of the British and American type. In making known the description of the Silurian rocks of Norway by Mr. Kejereslf †, I have recently shown how remarkable is the persistence of the Lower Silurian types (even in species)when these rocks are followed from Scandinavia into the British Isles, and to how great an extent this resemblance of type is preserved, even when the Atlantic is traversed, and that the same strata in the crust of the globe are again met with in North America. The occurrence in the south of Scotland of the *Maclurea magna* of Hall, of the *Isotelus gigas* in Ireland, and of the fossils of your calciferous sand-rock in our Scottish Highlands, are all most satisfactory proofs that the order in Canada and the country

* Quarterly Journal, Geological Society, November, 1855.

† Journal Geological Society, about to be published.

of our kinsmen is, with certain modifications, the same as in the ancient realm of Caractacus.

Excuse this hurried letter, and wishing you as successful a meeting as your labors and those of my other eminent friends in the United States deserve,

Believe me to be,

Yours very sincerely,

RODERICK I. MURCHISON.

To Sir W. Logan.

NOTE ON THE FOSSILS BY J. W. SALTER, F.G.S.

The specimens previously sent from Durness were far from satisfactory, and though clearly Palæozoic, could not be appealed to as settling their true place. They might, indeed, have been either Carboniferous or Devonian, although Sir R. Murchison had offered strong geological reasons to lead us to suppose them to be Lower Silurian forms. One cast in particular, which was at first doubtfully regarded as a *Maclurea*, though it had a right-handed curvature of the whorls, is now more properly referred to *Raphistoma* or *Ophileta.* And an *Orthoceras* present in the same beds could not decide the case. But those lately collected by Mr. Peach leave no doubt as to the true age of the beds. The principal fossil will be particularly interesting to Canadian geologists —being the same as one from the "Calciferous Sandrock" of Beauharnois, and which, being undescribed, has received the MSS name of *Ophileta compacta.* The genus is doubtful, and the fossil is probably only a sub-genus of *Raphistoma* (Hall)—the species of which have a wide umbilicus (bounded by a very prominent ridge) and straight-sided whorls. This species in Canada grew full an inch and a half wide, and had as many as six or seven whorls, flat above, and with a sunk, apex, and a very broad and wide umbilicus, so that the entire shell is much attenuated, and the inner whorls would easily break out, as in Mr. Halls's figure of *O. levata*, Pal. 4, 7 ; Pl. 3, vol. 1, fig 4. The whorls of that species are much less carinate below, and the umbilicus not nearly so wide. *O. compacta* will be fully figured and described in a decade of the Canadian fossils—it is unnecessary to say more of it here. It is curious that the *Euomphalus* (*Maclurea matutina*) which accompanies the Beauharnois fossil in Canada, is found also in the Highland beds, with another thick whorled species. Again, a

species of *Pleurotomaria*, known in America in the Trenton Limestone—the *P. subconica* (Hall)—comes so very near to one of our fossils, that it might well be only a variety of the species. The Highland fossil has rather more numerous whorls, and perhaps a broader band. The genus *Oncoceras*, so characteristic of the Trenton Limestone, also occurs, but of a larger species, with more numerous septa than the *O. constrictum*. As the calcareous beds in Canada frequently contain the fossils of more than one sub-division of the New York series, it is not more than we should expect, to find the above fossils associated in a single thick band of limestone. It is most satisfactory to find, in the northernmost part of Scotland, the representatives of the Calciferous Sandrock and the Trenton Limestones—as in the South of Scotland, that of the Chazy limestone.* And as the former repose upon a quartz rock with abundance of fucoidal impressions, the suggestion is obvious that such rock may, perhaps, occupy the place of the Potsdam sandstone.

NOTE.—Mr. C. Peach is now proceeding, at my special request, to endeavor to collect more fossils, not only at Durness, but throughout the Assynt and other tracts into which the same limestones and quartzites extend.

J. W. SALTER.

DRESSING METALLIC ORES.

A more practical subject than the majority of those discussed in this Section, was introduced by Prof. Silliman. This new method devised by himself, appears fitted to effect a very important saving in labour, and if so it must greatly facilitate the working of our Canadian mines, in districts where labor is dear and not easily obtained.

"Professor Silliman gave a brief description of a new system of dressing Metallic Ores. The Professor said the object of his remarks was to describe the general principle of a system of ore dressing, devised and put in practice at the Copper Mines of the Bristol Mining Company at Connecticut, under his own direction. The main features of this system are the perfect separation of the finer portions of the product of stamping and crushing, commonly known as "Slime Ore," from the coarser portions, without the aid of sieves or screens,—the application of the well known system of jigging directly to the stamped ore, which has hitherto

* The great *Maclurea* of Grivan, in Ayrshire, has been identified with the *M. magna* (Hall) by Prof. McCoy.

been incapable of this mode of treatment. The adoption of such mechanical arrangements has rendered the whole process of ore-dressing one continuous and self-sustaining system, in which human labor bears an exceedingly small ratio to the results obtained, compared with any system hitherto devised. In this system, the waste or refuse material is disposed of exclusively by gravity and moving water, without handling, while the ore is brought up to the highest mercantile percentage, however poor the original ore may be, no appreciable quantity of ore escaping as the waste.

The first of the above results is accomplished by the use of a new and exceedingly simple hydrostatic apparatus, devised by Mr. Stadtmuller, Mining Engineer to the Bristol Mining Company. (A model and sectional drawings of the apparatus were here shown to the audience.) The efficient cause of the success of this apparatus is the movement of a current of water in an inverted cone of iron, having an annular space surrounding an inner cone. The ore is admitted at the top, and is distributed over a conical surface to meet the ascending current of water, which is so adjusted in volume and force by a proper valve, and by a nice proportioning of the parts, that all the finer and more muddy portions of the ore are carried over the upper lip of the apparatus, while at the bottom escapes, with a more forcible current of water, through an adjustable orifice, all the coarser ore and metallic practicles These are certainly free from all slime, and are dressed upon a continuous arrangement of self-acting jiggs, and are carried immediately to a percentage suitable for market. The proportion of the ore, (about one half,) which escapes at the upper portion of the hydrostatic cone, is treated by alternate subsidence in large conical vats, the denser portions from the bottom of which are dressed upon Bradford's ore separators, (a pan of copper having the reciprocal motion of the miner's shovel,) which have been found, when served with only the class of ores properly adapted to them, admirably successful and economical. The ores, too fine or small in size for the separator, are treated upon a large conical table of circular form, with a very gentle current of water spreads in a thin sheet over the table, thus clearing the last traces of ore from the finer particles of sand with which they are mingled. This paper was illustrated by models and drawings, and by samples of the ore thus dressed, shewing in a very decided manner the beauty and efficiency of the system.

SUB-DIVISION OF THE LAURENTIAN ROCKS OF CANADA.

Hitherto these ancient and highly metamorphic rocks have been regarded by geologists as an inextricable mass of confusion. Sir W. E. Logan has set himself to unravelling their intricacies, with a patient perseverance of which hardly any other geologist is capable. A summary of his results was presented in the following manner:—

"I have already indicated the probable separation of the Laurentian rocks of Canada into two great groups: that characterized by the presence of much lime and that without; but from recent investigation, the result of which has just been reported to the Canadian Government, it appears to me almost certain that the former of these two great groups will be capable of subdivision, and that some of its bands of limestone, with their associated strata, are of sufficient importance to be represented separately on the map. Having followed out one of these bands of limestone through all its windings, for a distance of eighty miles, the object of the present paper is to exhibit to the Section its geographical distribution, and the forms it presents in the physical structure of the region which it characterises. What at first appear to be two bands of these limestones, emerge from beneath the Lower Siurian series in the township of Grenville, on the Ottawa, and run into the interior parallel to one another, striking N. N. E. They are about two miles separated from one another, and both, with the gneiss between, dip in one direction, which is N.N.W, at angles varying from about 50 to 70 degrees. Attaining the rear of the township, a distance of about ten miles, the two bands unite, and are found really to constitute but one, the thickness of which, as far as I can make it out, is from 500 to 1,000 feet. It is plain from this distribution that the limestone is part of the out crop of an undulating sheet, the ridges of which have been worn down. But in the horizontal section of an undulating surface, similar forms in the distribution of the rim, may be derived from the anticlinal or synclinal part of the undulation, and as the dips on the opposite sides are both one way, it is a question to which part the area belongs. Within a short distance of the eastern side of the limestone, in fact, touching it in one place, an intrusive syenite makes its appearance belonging to a mass which occupies about 30 square miles in the townships of Grenville and Chatham, and runs to a point in Wentworth. The intrusion of such a mass of igneous rock as this can scarcely fail to have had a considerable effect in modifying the

attitude of the strata which surround it. The crystalline condition of the syenite shews that it was slowly cooled under great pressure, and we cannot now say whether it was a deep-seated part of an outburst which reached the surface, as it was then constituted, or whether it was originally overlaid by masses of gneiss and limestone, which have since been worn away. In either case the probability is, that it would give to the strata now surrounding it, an anticlinal form. It seems probable, therefore, that the western dip, belonging to the eastern band of limestone, where it approaches the syenite, is a true one, and that the form between the bands is synclinal. This appears to be corroborated by the fact that where transverse valleys occur between them, the wearing down of the intermediate gneiss widens the calcareous bands, particularly the east one, and narrows the interval.

The calcareous sheet having thus the form of a trough, the western dip of the western out-crop must be an over turn; and two spurs of the rock which point to one another, the one turning south from the western belt, and the other north from the eastern, must constitute a subordinate anticlinal. Without reference to minor corrugations, the general form of the area would be that of two troughs joined together, each about a mile and a half wide, with an overturn dip on the west side, the one trough running north and south, and the other, as far as unconcealed by the superior fossiliferous strata, south-south-west and north-north-east. The opposite sides of this calcareous trough run into two valleys, which unite at its northern extremity. But though the limestone then crops out, the valley continues northward into Harrington, and after a short interval shows an isolated patch of limestone of about a mile and a half in length, by a mile in breath, possessing, of course, a synclinal form. Beyond this, the valley splits into two, and while one branch runs rather north of N. E., the other turns N. of E. Eacn of these valleys is paved with limestone, the distribution of which shews a continuation of the synclinal form, with a bend more to the eastward than before.

The calcareous band on the western side has been traced to the north boundary of the township of Harrington, whence it crosses into Montcalm. It there appears to turn to the westward, but it has not yet been farther accurately examined. The eastern branch has been followed for between six and seven miles into Wentworth, when it appears to turn upon an anticlinal

axis, and proceeding in a bearing S. S. W., for seven miles, it attains the southern boundary of the township, close upon the east side of the northern prolongation of the intrusive syenite. It runs in the same bearing for about 3 miles along the eastern side of this into Chatham, and becomes deflected to the S. E. by the main body of the syenite, to which it runs parallel for about three miles. It then folds upon the axis of a synclinal, and running N. N. E. for upwards of five miles, returns into Wentworth, where it gradually bends round more to the eastward, and in about five miles reaches a position in the Gore of Chatham. It here folds over upon the axis of an anticlinal, and turning S. S. E. it maintains this course for about eight miles, in which it crosses into the Seigniory of Argenteuil and reaches the vicinity of Lachute, where it once more bends upon a synclinal axis, and proceeding eastward for about a mile, plunges under the Potsdam Sandstone and is lost.

In the winding course derived from the plications of the strata, the limestone usually presents a valley on the geographical surface; but to the west of all the folds that have been described, a bold ridge of gneiss runs from the front of Grenville to the rear of Harrington, the distance being about 20 miles and the bearing N. N. E. On the west side of this ridge, about midway of the length, there are two areas about five miles long and broad, presenting the forms of valleys, which are underlaid by limestone, so distributed as to render it probable that they are two outlying parallel troughs joined together, belonging to the same calcareous sheet as the one described. There would thus be four main synclinals and three main anticlinals, and the breadth they occupy altogether is about eighteeen miles, giving about four and a-half miles for the breadth of each undulation.

Bands of dolomite sometimes accompany the limestone, which is often interstratified with bands of quartzite. The quartzite appears to be heaviest near the junction of the limestone and gneiss, becoming thinner and less frequent as we recede from the calcareous rock. The greatest mass of quartzite met with, had a vertical measure of 400 feet, and it was in stratigraphical position beneath the limestone. The quartzite and the gneiss on each side of the limestone are often very thickly studded with garnets, and in some cases the aggregation of these is so close as to constitute a granular garnet rock. In the Gore of Chatham a band of limestone about three-fourths of a mile to the

north-west of the one described, has been traced running paralle with it for seven miles. If the form which has been attributed to the first band be correct, the second would overlie it, with a great mass of gneiss between. A third band of limestone occurs about six miles north of the second; this has been traced for about four miles running east, which would be nearly parallel with the bearing of the second. In this bearing it has not yet been followed farther than to within a short distance from the line between the Seigniory of Argenteuil and the township of Abercrombie, towards the rear of both.

Continuous exposures of limestone have been met with on the west side of the Rivière du Nord at St. Jerome. They have been followed for two miles with a north bearing, and the strike of the stratification between Saint Jerome and the rear of Abercrombie, is such as to make it probable that the St. Jerome rock will ultimately prove to be a part of the third band. A feature common to both localities is the occurrence immediately near the limestone, of immense masses of lime feldspar. North of the Argenteuil band, eight miles, examined across the stratification, consist almost entirely of it, in the form of labradorite, of which masses of the opalescent variety are in some parts enclosed in a paste of the mineral without any play of colors, these feldspars are accompanied with hypersthene and ilmenite. This felspar rock is abundant at St. Jerome, and its stratified character is conspicuously displayed, the beds running parallel with the limestone.

Mr. Hunt has traced a band of crystalline limestone for eleven miles, running diagonally across the township of Rawdon in a north bearing. On the west side of this, lime-feldspar forms the great bulk of the rock exposures for twelve miles across the measures, and shows a well-marked stratification. It appears probable that the Rawdon calcareous band is the same as the St. Jerome band, and that a synclinal axis exists between the two, the turn of the calcareous band on which is covered up by the fossiliferous rocks to the south.

In Chateau Richer below Quebec, a band of limestones occurs about a mile from the fossiliferous deposits, and to the northwest of it lime-feldspars present, a breadth of eight miles. On an island near Parry's Sound on Lake Huron, Dr. Bigsby observed the occurrence *in situ* of the opalescent variety of labradorite, and the name of the mineral reminds us of the existence of the rock beyond the eastern end of the province. It thus appears probable

that a range of rock will be found winding irregularly from one end of the province to the other, of sufficient importance to authorise its representation by a distinct color on the map, and a distinct designation in geological nomenclature."

THE DEPOSITION OF NATIVE METALS IN VEIN FISSURES, &c., BY ELECTRO-CHEMICAL AGENCY.

Prof. Chapman, of University College, Toronto, brought forward at considerable length his views on the origin of native metals in vein fissures. These views are at variance with those of the majority of chemists and geologists, at least in their application to the copper deposits of this continent. We give, therefore, an extended, and we believe faithful statement of Prof. Chapman's views from the *Gazette.*

"From the known fact that solutions of various metallic salts may be decomposed by voltaic agency, and the metal obtained in the simple state, it has long been a favorite theory with many geologists, that depositions of native metals, in veins, &c., are due to a similar cause. That such may be a perfectly legitimate conclusion in many instances, I am quite ready to admit; but, in applying this view to any particular case, it is necessary, unless the explanation is to be regarded as a mere theory of convenience, that certain collateral circumstances be not altogether excluded from consideration. If these circumstances oppose themselves to our theory, and remain by it altogether unanswered; nay, if but a single well-proved fact withhold its concurrence from the conditions demanded—surely it is more consistent with our obligations to scientific truth, that we abandon the theory at once—however plausible in itself, and however convenient in its application—rather than attempt to maintain it by keeping these opposing conditions out of sight, or by wilfully ignoring their value. Now, my object in the present brief communication, is simply to bring before the notice of the Section, certain facts, experimental and otherwise, which appear to me to prove most incontestibly, that, in nine cases out of ten, the so-called electro-chemical theory as explanatory of the organ of native metals in veins, is entirely fallacious.

We will take the case of native copper, under its known conditions of occurrence in the Lake Superior District and other parts of North America. The electro-chemical theory is constantly being brought forward in explanation of this particular

case. As the copper is here, nominally, in intimate association with vast masses of erupted trap, it might naturally be inferred that the presence of both trap and copper was equally due to igneous action; or, where the copper occurs in small strings and arborescent masses apart from the trap, to a modification of this action, in volatilization and subsequent reduction of chlorid of copper or some other volatile compound. But the upholders of the electro-chemical theory, find these views apparently too simple for their approval. It is very possible that the copper may have originated by some other agency; but the following facts will, I think, shew that this unknown agency was not the electro-chemi cal principle, whatever else it may have been. The copper is very constantly found in the interior of zeolites or calc-spar, or surrounding crystals of the latter substance in such a manner as to shew that the calc-spar was solid before the solidification of copper—the copper often presenting the most sharply-cut impressions, even to the minutest striæ of the crystals of the calcareous spar. I mention this well-known condition of occurrence first, because it is commonly referred to as affording a strong proof of the deposition of the copper according to the electro-chemical theory, although nothing can really be more fatal to its reception.

The conditions of occurrence just alluded to, may, in the estimation of some, disprove the igneous origin of the copper; but equally do these conditions disprove its origin according to the other view. In the first place, it must be remembered that the zeolites, and carbonate of lime also, are *non-conducting bodies*; and hence that no deposition of metal can be made to take place upon them, by the electro-chemical process, unless their surfaces be first coated with graphite or some other conducting substance. This may be readily shown by the simple method of ascertaining the conductibility or non-conductibility of mineral bodies employed by Von Kobell. The substance under examination is to be placed in a solution of sulphate of copper, and touched by a slip of zinc, or a piece of zinc bent into a kind of tongs may be used to hold the mineral. A deposition of metallic copper will rapidly take place upon conducting bodies, such as pyrites, galena, graphite, anthracite coal, &c., &c.; but not upon non-conductors, as quartz, the felspars, garnet, calc-spar, malachite, and other similar minerals.

This fact, when forced upon the attention of those who maintain the electro-chemical theory, has been allowed to be "an objection"; but that is not the proper term. It is an insuperable obstacle—

nothing less—to the legitimate adoption of this theory; and until it can be satisfactorily explained away, to attempt to account for the origin of the copper by reference to the principle in question, is surely, to say the least, a mere waste of words. A few other objections to this electro-chemical hypothesis may be briefly touched upon. This hypothesis exacts necessarily a solution of the copper in some form or another.

Now, many of the minerals associated with these copper deposits —carbonate of lime, for instance,—are readily altered by immersion in cupreous solutions; whereas the crystals of carbonate of lime actually occurring with the copper, as well as those met with in its immediate neighborhood, exhibit no appearance of alteration, but retain on the contrary, their white color and original surface condition. By placing these same crystals for a short time in a solution of sulphate of copper, they become converted at the surface into malachite, or into a copper carbonate of similar aspect, more especially if the solution be kept at a moderately elevated temperature. Again, if the enormous deposits of Lake Superior originated in this manner, might we not reasonably look for the presence of vast secondary products, the results of the chemical decompositions which must necessarily have taken place. It is asking almost too much to assume that these secondary products may, from their solubility, or from other causes, have entirely disappeared, without leaving behind them very manifest traces of their former presence. But, yet again, if we assume this origin for the copper, we must necessarily assume also that the cupreous solution came from above: that it is to say, from an *overlying*, not from an *underlying* source; as otherwise, from the filling up of the fissures, the supply would quickly have been cut off. This involves manifold difficulties of an easily imagined character.

My object, in the present note, is not to propose theories in explanation of the origin of these copper deposits, but simply to shew that if one of the hypotheses already advanced with this view—that which attributes the larger copper masses (in intimate association with the trap) to direct igneous action, and the smaller, arborescent and more distant masses to gaseous emanations as previously explained—be not free from difficulty; the other, or so-called electro-chemical theory, is, in the cases referred to, absolutely untenable; and, amongst other reasons, chiefly for this, namely: that the deposition of the copper on non-conducting

bodies is opposed to all known principles. It is to be hoped, therefore, that those who still feel inclined to adopt and maintain this theory of convenience, will not forget to enlighten us as to the cause of the peculiar departure from known laws exemplified in the cases under review."

QUESTIONS CONNECTED WITH THE SALTNESS OF THE SEA.

A second paper by Professor Chapman, related to the use of the Saltness of the Sea. This is a subject of which too narrow views should not be taken, since it is easy to perceive many important uses secured by the substances held in solution in the ocean. Professor Chapman brought forward an interesting experiment, illustrative of the equal diffusion of this saline matter, under circumstances unfavourable to transference of the water itself; and leading to the conclusion that one important consequence of the saltness of the sea is the regulation of the rate of evaporation from its surface.

"It is a current opinion that, in consequence of the surface of the sea becoming salter and hence heavier by evaporation, a downward motion of the surface water necessarily takes place; and hence Lieutenant Maury's hypothesis that the sea is salt in order to produce circulation. Some time ago I suggested another object in explanation of the saltness of the sea, viz.: that the sea is salt in order to regulate evaporation. The greater the amount of salt, the slower the evaporation of the water,—and the reverse: so that, if by any easily conceivable cause, or combination of circumstances, the normal degree of saltness becomes either increased or diminished—a kind of self-regulating force is set up to resist the continuation of the abnormal action, until time restore the balance. Even leaving out of consideration the equalizing effects produced by the accession of fresh water to the surface of the sea by rain and rivers, it seemed to me that the principle of diffusion was in itself sufficient to prevent the sinking of the water thus affected by evaporation; or, at least, to prevent the sinking of this water to any extent. But how to prove the point. The fact that the saltness of the open sea was substantially the same at considerable depths and at the surface, says nothing; as it would necessarily follow, that for every heavy particle of water that sunk, a lighter particle would rise up to supply its place; and hence the composition of the water would be kept uniform, without the principle of diffusion being in any way required to explain the phe-

nomenon. After some consideration I adopted the following method, as one sufficiently trustworthy to afford an answer to the question under review:—I procured a leaden pipe one inch in diameter, and bent into the form of the letter U: each upright being about thirty-nine inches in height, and the connecting piece at the bottom rather more than twelve inches long. This I filled up to about an inch on each side with a solution of common salt in rain-water (the salt being present to the amount of 3.786 per cent.,) and then I carefully closed one end, leaving the other end open, but protected from dust by a cone of silver-paper fixed on a bent wire, and so arranged as not to prevent evaporation. The per centage of salt (3.786) was carefully ascertained, and the apparatus left in an unoccupied room, the window and door of which were kept almost constantly open, in order to promote the evaporation of the solution as much as possible. After the lapse of about three months, (April 18 to July 14,) portions were taken from each end of the tube, and from the connecting piece below, (a small orifice being made in this;) and the amount of salt in each portion was accurately determined. Now if the principle of diffusion had not been brought into play, it is evident that the solution in the open limb of the tube ought to have been stronger than that in the closed limb, although, by the circulating process, the amount of salt at the top and bottom of the former might have been alike; and, again, it will be equally evident that if the principle of diffusion were brought into play, the supposed sinking of the surface solution, as the result of evaporation, must be altogether imaginary. Six separate determinations, two from each of the three portions of the tube, shewed a per centage of salt essentially the same. The following table exhibits the results obtained:

		Solution.	Am. of Salt.	Per ct'ge of salt.
1	A. From the top of the open limb,..	302·261..	11·59...	3·030..
	B. From the bottom of the same,..	300·24...	11·51...	3·835..
	C. From the top of the closed limb,.	288·60...	11·055..	2·831..
2	A. From the top of the open limb,..	264·84...	10·16...	3·837..
	B. From the bottom of the same,..	290·10...	11·12...	3·833..
	C. From the top of the closed limb,.	306·66...	11·75...	3·832..

These experiments justify us, I think, in assuming, that owing to diffusion, the surface waters of the sea do not become heavier than the lower strata simply by losing water by evaporation. It is quite true, that under the influence of evaporation a lowering of temperature may take place, and that an upward and downward circulation, to a certain extent, may in this manner be pro-

duced*; but the same reasoning will apply to bodies of fresh-water, —and hence the object of the salt in the sea remains still unexplained. In conclusion, therefore, I feel justified in expressing my sustained belief, that the theory which I have proposed to account for the saltness of the sea is worthy of our acceptance; this theory being, that the sea is salt, essentially if not principally, in order to regulate evaporation.

NEWER PLIOCENE FOSSILS OF THE ST. LAWRENCE VALLEY, by Professor Dawson. The object of this paper was in the first place to notice several fossil shells recently found by the author and others in these deposits, and which did not appear to have been previously observed. The species mentioned were:—

Natica Heros, Say, - - - - -	Beauport.
Natica Grœnlandica, Beck, - - - -	do.
Fusus tornatus Gould, - - - -	Montreal.
Fusus harpularius, Couthoy, - - - -	
Rissoa minuta, - - - - - -	Montreal.
Turritella, (like *erosa*,) - - - - -	Beauport.
Bulla oryza, Tott, - - - - -	Montreal.
Spirorbis sinistrorsu, Montagu, - - -	do.
Univalve, (perhaps *Menestho albula*) - -	

Most of these are shells now living on the Atlantic coast of America, north of Cape Cod, and some of them ranging very far north. The paper then referred to the distribution of the various kinds of drift in the vicinity of Montreal, and to the conditions of the sea areas, in which the shells and other marine animals of the Newer Pliocene period existed in the St. Lawrence Valley. "Good evidence exists of a sea beach on Montreal Mountain, at an elevation of 470 feet above the sea. The sea area corresponding to this beach must have extended to the Laurentide hills and the escarpment of Niagara, and communicated freely with the ocean on the east. On the other hand there are lower shores of the same period only 100 feet above the St. Lawrence. These must have belonged to a

* It should be stated that no intermixture could have taken place in the closed limb of the apparatus described above by ascending currents produced by unequal temperatures, as the temperature of the lower portion of the closed tube was kept purposely lower (or at least prevented from becoming higher) than the upper portion by means of a damp rag permanently attached to it.

very narrow prolongation of the present gulf of St. Lawrence. The conditions of climate, ice, drift, &c., corresponding to these different shores must have been very diverse."

Again, in the stratified drift, it is possible to recognise, within a few inches of each other, a bed containing deep-sea shells, and another containing species that are littoral; these sea bottoms corresponding to different levels of the land. It is evident that any conclusions with reference to the climate indicated by the marine fauna of these successive beds of marine detritus, must take into account these fluctuations of the sea level, and the changes in animal life consequent on them. Taking these into account, positive and reliable results may be attained; and the study of such districts as the St. Lawrence valley may be made to contribute toward the elucidation of the conditions of life in older formations."

NORTH AMERICAN LAKES.

The fluctuations of level of the American lakes, have often formed a subject of inquiry and speculation. They were brought before the Association by Mr. Whittlesey. "These fluctuations presented three distinct features. There was first the general rise and fall, extending through a long period of time; then the annual rise and fall which occurs regularly within a certain period of each year, and which he styled the annual fluctuation; then there was the third, a local, fitful, and irregular oscillation, lasting sometimes from three to five minutes, and varying in duration from one to twenty-four hours. He had no difficulty in explaining the general rise and fall of the lakes, as they were merely the reservoirs for the drainage of the country of the surplus water, which passes thence by the St. Lawrence as a general opening to the sea. Mr. Whittlesey read a variety of statistics in reference to the range and extent of the two first named fluctuations, and said he was unable to find in these, or in the examinations he had made, any confirmation of the popular belief that there is a seven years rise and fall of water in the Lakes. He then directed attention to cause of the third phenomenon—the irregular fluctuations which occur without any particular known cause. Although these pulsations, as they might be termed, were the first to attract notice, they were the last to have received any attention. They occur in all conditions of the atmosphere, but whether produced by electro-magnetic influence or not he could not say, although he thought it not unphilosophic to look in that direction for their cause."

SUCCESSION OF FOSSILS IN BRITISH ROCKS.

Prof. Ramsay presented an elaborate paper on the succession of life in British rocks, illustrated by a diagram exhibiting the number of species and genera of fossils in each formation, and the number common to each pair of successive formations. The subject is a large one, even in the facts relating to a single limited area. It is still more difficult if we attempt to extend our view to the world; and in reasoning on the facts attained, defects in the data appear at every step. Above all we are as yet quite uncertain as to the relative value in point of time of geological formations, or of the intervals which may separate them, nor do we know the proportion of species lost and preserved in any one epoch. Prof. Ramsay, however, took a firm hold of his subject, and pointed out some very remarkable facts indicated by his comparisons of British formations.

"Professor Ramsay said the subject to which he intended to direct the attention of the Association was one which had necessarily engaged the attention of Geologists ever since it became an established fact that there was such a thing as order in the superposition of strata, each formation being characterised by its peculiar suite of organic remains. It was found that genera and species had long succession, and had several times been extinct on the face of the earth. It was an easy way of accounting for this to suppose that each great extinction was marked by some great catastrophe which swept all clean from the face of the earth, and then there was a new creation. Few geologists now believed this, and some assert that as one species died out another was created, so that had we all the links perfect there would be found a gradual dovetailing—a perfect passage of one formation into the other. The diagram before them he had constructed to aid himself in investigating this subject. It was constructed purely with reference to the formations in the British islands, and the various fossils found in these various formations. But the same general laws would be found to obtain, in a modified manner, in other localities. The first division in the diagram is the Slandeilo flags, where we have the first development of organic life. In these we have twenty species and fifteen genera. Eight of these are trilobites. Apparently the succeeding Lower Silurian rocks rested upon them with perfect conformity. There is no appearance of a break in the series; yet we find only find five genera and one species pass into the next strata. What was the reason

for this extinction of species and the sudden appearance of a great number of others, he could not say. He brought this subject before the Association to hear, if possible, some suggestions as to the illustration of this important question. In the Lower Silurian we have 445 species and 150 genera; in the Upper Silurian 464 species and 150 genera, while 14 genera pass from the Lower into the Upper, and 43 species. There is here a considerable link, yet the break is remarkable, and is marked by strong physical unconformity. In the Devonian we have 415 species and 131 genera. There is apparently a much more gentle passage from the Upper Silurian to the Devonian than from the Lower to the Upper Silurian, yet only 8 species and 60 genera pass into the Devonian. In the Carboniferous we have 1646 species and 302 genera. The passage from the Devonian to the Carboniferous is easy, yet only 58 species and 43 genera pass into this formation. It is a remarkable circumstance that there is here a great decrease in the development of life. In the Permian we have only 157 species and 78 genera, while only 37 genera and 5 species pass from the Carboniferous into the Permian. When we reach the bunter sandstone formation we have no fossils at all in Britain, so that there the break is complete. In the Keuper we have 18 species and 15 genera. In the Lias 454 species and 129 genera; of these there pass into the Oolite 62 genera and 6 species. In the Lower Oolite we have 994 species and 224 genera, 89 genera and 36 species of which pass into the Middle Oolite. The Middle Oolite yields 107 genera and 264 species, and the Upper Oolite 130 genera and 218 species. From the Middle to the Upper Oolite there pass 30 genera and 9 species, while 36 genera and 5 species pass from the Oolite to the Cretaceous; 49 genera and 16 species pass from the Lower Cretaceous to the Upper Cretaceous. In the Upper Cretaceous times we have a great development of life, viz., 1275 species and 314 genera. In the Middle Eocene we have 977 species and 274 genera. We have no Miocene in Britain. In the Pliocene we have 631 species and 202 genera; and from the Pliocene there pass 50 genera and 236 species to the Pleistocene. With respect to physical breaks in the foregoing formations, the Permian rocks lie quite unconformably on the Carboniferous, and the New Red on the Permian; and though in any one locality where the marine Cretaceous beds lie direct on the Oolite, they appear conformable; yet the local occurrence of intervening breaks in the Purbeck and Wealden beds shew the

enormous lapse of time that lay between; and it was argued that between other strata similar lapses of time may have intervened, possibly marked by the occurrence of great rivers, the deposits of which have not been preserved. The most perfect sequence of formations, even over large areas, was only a collection of fragments. Mr. Ramsay then referred at some length to the Glacial Epoch. It was generally believed that the whole of the British territory, if we except perhaps some of the mountains in the north part, had been submerged during the Glacial Epoch. We find marine shells of an Arctic type at 1,300 feet above the level of the sea. This of itself would not be a demonstrative proof that our country had a cold climate during that time; but proof is quite perfect of glaciers having existed at that period. He had recorded it as his opinion that the chief causes of the extinction of species, and of the changes of the species, in the different formations, were to be found in the great changes in the physical geography, such as large tracts of land being for a length of time out of water, and being again submerged; and also from climatal changes, which might be due to changes in physical geography."

FORMATION OF CONTINENTS.

A very remarkable paper was read by Prof. Pierce, on the origin of the great lines of land and water on the surface of our globe. The author went back to the supposed fluid condition of our planet, and attempted to show that the diurnal solar action on a cooling sphere would establish a tendency to the production of lines of cleavage along great circles tangental to the arctic circle, these directions being actually those of the principal lines of our existing continents. This view, though probably not current with most of the geologists present, points to at least a curious coincidence, which in its connection with the direction of the earliest dry land and our modern coast lines, merits attention.

" Professor Pierce remarked that the principal lines of the continents were great circles, tangent to the polar circle. This was especially the case with the coasts of the Pacific ocean. He illustrated this on the terrestrial globe. He then pointed out the same fact as regarded the eastern coast of Africa, the eastern coast of Hindostan, the eastern coast of Asia, the eastern coast of North America, the western coast of Hindostan, the line of the eastern Archipelago, the western coast of America, and (perhaps) the western coast of Africa. Any one might perceive these

remarkable facts by elevating the pole of the terrestrial globe twenty-one and a-half degrees above the horizon and then causing the globe to revolve. The northern line of South America, a portion of the coast of Africa, a portion of the Central American coast, most of the Pacific Islands, &c. were portions of great circles, tangent to the tropics. Prof. Pierce said this seemed to indicate that the sun had someting to do with the formation of continents. Indeed the sun had very great influence even now, and when, at the formation of the earth the mass was in a fluid state, the difference of one or two degreess might make all the difference whether congelation should take place at one time during the day or not. And the action of the sun, in allowing the mass to cool or grow warm, to congeal or solidify, would cause a tendency to the formation of lines of cleavage in the mass or crust of the earth. These lines of cleavage were all that geologists required to enable them to account for the formation of chains of mountains and lines of coasts. The solidifying of certain portions of certain continents would account for the formation of ocean currents.

PHYSICAL GEOGRAPHY OF AFRICA.

Professor Guyot read an interesting paper on the little known and hitherto apparently exceptional physical geography of Africa, basing his conclusions on the discoveries of Barth, Livingstone, and other late travellers. We are sorry that we cannot give an abstract of this paper.

DIRECTION OF THE CURRENTS OF DEPOSITION AND SOURCE OF THE MATERIALS OF THE OLDER PALÆOZOIC ROCKS.

Glimpses of large views on this subject have been given at various times by Prof. Hall and his brother Geologists of the United States. In the present paper Prof. Hall gave a large extension to our previous conceptions of the subject, assigning in the formation of mountains an influence to sedimentary deposition which geologists have not hitherto attributed to it. Prof. Hall's view on this subject, may be overstrained, but it embraces important general truths, not to be neglected in any attempt to explain in detail the formation of our continents.

" He said that in treating of the elevation of mountains, sufficient consideration had not been given to the distribution of the material forming these mountain chains, in its unaltered condition. All the materials they knew of were stratified, and had been

metamorphosed more or less. He proposed to occupy a few moments in following the direction of the ancient currents, and to show their parallelism with the mountain chains in the Laurentian Mountains, north-east of them, which are nearly parallel to the Appalachian chain. The Geological Survey would show whether these sediments were thicker to the eastward than to the westward; but he thought the direction of the currents, which deposited the materials forming the Appalachian chain, was from the north-east. They had certainly good evidence from the fact that the strata are of the same age, and are much thicker from the north-easterly direction than from the south-west. They gradually thin in that direction, and, as he believed they were deposited by water, the further from the source they would be the thinner. They had reason to believe that in the south-west these strata were much thinner than in the north. Taking the Hudson River group which consists of sediments stretching to the south west, with a thickness of 1000 feet to the north east of us, it thins down to 600 feet in Pennsylvania, and finally in the Mississippi valley the thickness is not more than 100 feet. Passing from the Hudson river group and over a lapse of time, to the Oriskany Sandstone we find the deposits from the north east. At Gaspé the thickness is 7000 feet, in New York it is reduced to a few hundred feet and the stata thin out in a westerly direction. The conclusion he had arrived at was that along these lines of deposit where the greatest accumulation of sediment has been made, and where we have the greatest elevation of mountain chains, this merely coincides with the direction of the ancient currents, and that the Appalachian mountain range has not been more uplifted than the other portions of the country, or than the plain between these and the Atlantic. In New York and Pennsylvania they got to the Potsdam Sandstone, and, therefore, there was no uplifting of any previously existing rocks before the Appalachian chain. The folding and plication had commenced at an early period—at a period before the upper Silurian Rocks were formed, and we find these strata plicated and uplifted and had metamorphosed in a considerable degree. We get no lower than the Potsdam Sandstone in any part of the Appalachian chain, and we can demonstrate that no lower mass has had anything to do in giving us the elevation of this mountain chain. The Prof. then referred to his examination into other formations in confirmation of his hypothesis that elevating forces had not

caused uplifting of these mountain chains. On the contrary, if there had been no folding and plication, this range of mountains, he thought, would have been twice as high as they now are.

ORIGIN OF COAL.

Mr. Whittlesey who presented a paper on this subject, is in this matter a sort of geological heretic, who maintains a view long since exploded, and now not seriously entertained by any geologist familiar with the decided proofs of vegetable origin presented by all our beds of coal, even by those that have by metamorphic processes been converted into anthracite. Views of this character constantly make their appearance in Scientific Associations, and are usually listened to with patience, though regarded, in the words of one of the speakers on this paper, as "going backward in the progress of geological science."

GRAPTOPORA.

A new genus of polyzoa, allied to the curious silurian fossils known as graptolites, was characterised under this name by Mr. Salter. There appears some reason, however, to believe that this proposed new genus is identical with the *Dictyonema* of Prof. Hall.

We were so unfortunate as not to hear the papers of Prof. Emmons on the remarkable fossils recently found by him in North Carolina, and by Prof. Hitchcock on the much controverted question of the age of the Red Sandstone of Connecticut, nor have we obtained any detailed report of them.

GEOLOGICAL SURVEY OF GREAT BRITAIN.

On the last day of the Session, Prof. Ramsay gave a verbal explanation of the mode of conducting this great survey. The American geologists present were very much interested in the subject; and spoke in terms of admiration of the thorough manner in which the work is carried on. Prof. Ramsay was requested to prepare his remarks for publication. In the mean time, therefore, we do not publish an abstract, hoping to have the paper *in extenso* for our next number.

GEOLOGICAL SURVEY OF MISSOURI.

Prof. Swallow followed Prof. Ramsay with an account of the survey of this and the neighboring States. The principal feature referred to was the enormous extent of the coal fields in the West, and the remarkable subdivision of parts of their margins into isolated patches or basins.

[illegible] and [illegible] could have [illegible]

[illegible] present [illegible] paper on this [illegible] geological heretic, [illegible] and now not seriously [illegible] longer [illegible] with the dreaded [illegible] beds of coal even by [illegible] converted into [illegible] make their appearance [illegible] listened to with patience [illegible]

[illegible] to believe that this [illegible] with the *Dictyonema* of Prof. Hall. [illegible] to hear the papers of Prof. [illegible] recently found by him in North [illegible] the much controverted question [illegible] of Connecticut, nor have we [illegible] of them

[illegible] during this [illegible]

[illegible]

Several other important papers were on the list; but time failed to read them, and they will probably appear in the published proceedings of the Association.

SUBSECTION OF ETHNOLOGY AND STATISTICS, &c.

This was a vigorous off shoot from Section B; and under the able management of Prof. Wilson, Prof. Anderson, and other men of kindred spirit, entered actively into those great questions that affect the natural history of Man. The work of this section was of great popular interest, and of no little scientific importance. It will go far to rescue American ethnology from the opprobrium that has fallen upon it, in consequence of the crude and rash speculations that characterise some recent publications on this subject. We can give but a few fragments indicating the topics that were disscussed.

The first paper in this sub-section was that by Mr. Lesley on the word "*Celt.*" It was full of ingenuity and erudition; but we confess that, after all, we prefer to follow the ingenious author as a guide in the complexities of the structure of coal fields rather than in philological niceties. The paper, besides, is one that cannot be reduced to the form of an abstract.

THOUGHTS ON SPECIES.

No subject is of greater interest in Natural History than the investigation of the real nature and limits of species, and no American naturalist is better fitted to grapple with it than Prof. Dana. The following report does no justice to his argument.

According to Prof. Dana, and we think the view most philosophical, our idea of a species should consist of certain essential properties common to all the individuals, and in the organic world the power of invariable transmission of the properties; but, whether in the inorganic or organic world, we should regard variations within fixed limits as a law of every species under the influence of external agencies. This view of species, and we might indeed add any intelligible view of the subject, leads inevitably to the doctrine of the common origin of all the individuals of any species capable of continuous reproduction.

"Professor Dana said it might be well perhaps to examine the question of species synthetically, comparing the results of observations with the utterings of science, and he proposed the three

following questions:—1st. What is a species? 2nd. Are species permanent? 3rd. What is the basis of variations in species?

And first he said, that the idea of a group which is the common definition, was not essential, and indeed tended to confusion. Looking first at inorganic nature they learned that each element was represented by a specific amount or law of force. Thus taking the lightest element as a unit, oxygen would be found expressed by 8, and was of the same value in all its compounds. The resultant molecule was still equivalent to a fixed amount. Hence the essential idea of a species is that it corresponds to a specific amount or condition of centrated force defined in the act or law of creation. In the organic world the individual was involved in the germ, which possessed powers of developement to a completed result, and this also corresponded to a measured quota or specific law of force, though there was no unit by which to measure it, and though there might be different kinds of force. The same definition of a species would apply here, and thus species was in the potential value of the individual whether one or many existed, and the precise nature of the potentiality in each was expressed by its whole progress from the germ to its full expansion. 2nd. As to the permanence of species, it was found in the inorganic world that the element was always the same: oxygen was always 8, and all nature was characterised by fixed numbers. This being so for inorganic nature, must be so everywhere, for the principles which pervaded nature were not of contrariety; but of unity and universality. If the kingdoms of life were not made from the units which exhibited themselves in their simplest condition—if these units were capable of blending, they would not be units, and life would be but a system of perplexities. It might be seen, too, that the purity of species was guarded in nature. Both in the animal and vegetable kingdom, hybrids were her aversion as far as yet observed. Least of all was it to be expected that the law of permanence, so rigid among plants and the lower animals, should have its main exception in man. Yet if there were more than one species of man, the number of species must become indefinite by intermixture. It would have been a clumsy mode of giving man the control in all the zones of the earth, to have made him of many species capable of hybridization in opposition to the general law of nature. It would have been using for the propagation of the human race, a process which produces impotence among animals. It is true that different inor-

ganic species continue to form new units ; but it is not by indefinite blendings, but by a definite law ; and if such a law existed in organic nature, it would also be in general an essential part of the system, easy of discovery. But there were variations in species, though they could never extend to the obliteration of the fundamental characteristics of the species. No substance could be independent of any other. The law of mutual sympathy was one of the most universal in nature. The planets where modified by each other, and one chemical substance by the other. Each body had its own fundamental force, and the relation of this to others was a part of the idea of the species; and this process of variation was a law of universal nature acting on the law of a special nature and compelling the latter to reveal its qualities. This was one of the richest sources of truth which was open to research, and hence we should not regard the individuals which were conspecific as constituting a species ; but each one, as an expression of the species in its potentiality, and under some one phase of its variations. The system of nature must be conceived of as a system of units continually adding to the number of representative individuals by self reproduction; and all adding to their varieties by mutual sympathetic reaction."

CRANIAL TYPE OF THE AMERICAN RACE.

The clever though not over scrupulous writers of the so-called "American School of Ethnology," have built largely on the researches of Dr. Morton, a man of great industry and ability, but not fully aware of the use which would be made of the materials he had collected. Professor Wilson has been going over some of Morton's ground, and is surprised to find his general statements not borne out by facts. The statements of this paper would seem to show that the whole subject of American crania requires re-investigation.

" Prof. Wilson spoke on the supposed uniformity of Cranial Type throughout the American race, and recommended inquiry on this question so frequently forced on the attention of the Association, and in the meantime not to come into collision with theologians ; There was a great variety in forms of the head, colour of the hair, and the osteological structure of the human frame. It was a question not only whether all human beings agreed in form, but whether they had always agreed ; and in order to that discovery the search must be made in ancient tombs and tumuli. By ethnologists of the American school important results had been

built upon the ground of the observations made by the celebrated Dr. Morton, and it was not to be wondered at that that gentleman was taken as authority, for he possessed a scientific mind and was a very careful observer. But, without disparaging that great writer, he thought his deductions ought to be tested by farther researches. The Doctor's conclusion was that a universal type of cranium pervaded all the American family, which he divided into the two classes of Toltec and Barbarous, though he regarded the division as intellectual rather than physical. The form which he found to be general in the skulls of all these tribes was marked by much greater breadth from side to side than from the frontal to the occipital bone, differing in that respect from the European and African races; and in the American races he found that the forehead was not arched as in the others. All this had been reiterated by most subsequent American writers, and particularly by Agassiz. Here the learned Professor read several authorities to show the generally strong affirmation on the part of American writers, of the unity of race throughout the Continent, always with the same type. Now, in England he had paid a great deal of attention to the forms of heads found in the ancient tombs of the old country and in Northern Europe, and had noticed the shortness of the longitudinal section in those heads, which, when he came to this country, he wished to compare with the same characteristic which he had believed was to be found in the American crania. He had therefore procured a number of Indian heads, in the full expectation of finding this form; but was entirely disappointed in the result of his investigation. He found very few of the heads of the type described by Morton; yet so strong had been the impression on his mind that it was long before he became convinced that the variety was general. He had examined, however, in all twenty-eight heads, from the country south of the Ottawa and north of Lakes Erie and Ontario, and of these twenty-five essentially differed from the characteristics described by Morton. It was true that Morton had examined two hundred skulls, and he only twenty eight; but taking Dr. Morton's collection even as it now existed, with all the additions since made to it, there were in it only sixteen skulls of any one tribe. Therefore his twenty-eight all coming from a small section of country, afforded as good *data* to work from. However, Dr. Morton made an exception from his type of the Esquimaux, which he regarded as analogous to the Mongols, though he admitted that philologically

the Esquimaux did not differ from the other American tribes, so far as generalization could be made of so many different dialects. He here pointed out a drawing of the skull of a Scioto Indian, which he showed by quotations from the writers of Morton's school, was to be considered as the most perfect type of the American head. It differed from the heads of the modern European inhabitants of the country; but it seemed to him to differ as much from that of the northern Indians.—Besides, as the form of the northern Indian differed from the southern Indian, it approached that of the Esquimaux. The Seminole, again, as drawn by Morton, approximated to the Peruvian head, and differed from the accepted type. He then gave several measurements of heads, from Morton's book, to show that even these did not bear out the theory of Morton. He then mentioned a head found near Barrie, in which the peculiar characteristic noticed by Morton—the flat occiput—was so remarkable, that the skull would stand better on that than on any other side; but this was so large a deviation from other heads that it was in all probability an example of formation by artificial means, which indeed he thought might probably be the cause of the peculiarities which had been looked upon as ethnological, but were really archaeological facts. He mentioned, moreover, that the pyramidal form, another great feature in the heads observed by Morton, was most strikingly developed in the Esquimaux head.

CLASSIFICATION OF THE HUMAN RACE.

A further caution to this school was administered by Prof. Anderson, who addressed the Section on this subject, with a view of showing the importance of some comprehensible classification of the varieties of the human race, in order to the correct observation of those facts upon which one school of ethnologists founded their opinion that mankind consisted of several species, or of one species planted in several centres of creation. "To illustrate the difficulties in the way of such classification, he mentioned that Viréy divided the race into two species—the white and the yellow; the black and the brown. But he found all sorts of difficulties in this classification. Take, for instance, the Arabians—the purest of the Semitic races—and he found the Arab in one place with light hair and blue eyes, while in the hot regions of the desert the Arab very nearly approached the Negro. The same changes occurred in the Hindoos and great Iranian races, as

they descended from the mountains to the hot deltas of the rivers and to the sea coast. This was also to be remarked in Africa; so that the distinction into white and yellow, black and brown, formed no really useful classification. Jacquenot spoke of three species of men; Dumoulin of eleven, of which the first was the Celto-Scyth-Arab, the meaning of which he could not divine. Colonel St. Vincent made eleven species; and Luke Bird, the editor of the *Ethnologist*, sixty-three; while Dr. Morton's posthumous works made twenty families, each of which the doctor plainly looked on as a distinct species. These could not all be right. Again, Agassiz considered that there were at least eight, and perhaps a thousand centres of creation, though there was but one species; but there were many difficulties about that theory, as it would require a new miracle of creation for each supposed centre; and it was a good rule in physics not to allow new creations except where they were absolutely required. He concluded by saying that he thought the proper attitude for Ethnologists to assume was to hold all theories as provisional, keeping themselves ready to be convinced by any new facts whenever they appeared.

A lengthy exposition of the arrow-headed characters of Assyria was given by Rev. Dr. McIlvain; and a paper by Prof. Reid was read, advocating the use of English as a universal language. These papers we cannot do justice to in our remaining space, nor do they properly belong to our field.

ANCIENT MINING ON THE SHORES OF LAKE SUPERIOR.

"Professor Charles Whittlesey read a paper on the Ancient Mining Operations of Lake Superior. After describing the geography of the copper region of Lake Superior, he said that throughout the country indications appeared of mining operations carried on by an ancient people. The works of these people were mere open mines like quarries, never descending more than about thirty feet below the surface. These mines had a peculiarity which distinguished them from all others, that the metal was found in pure masses. These masses the ancient miners seemed unable to deal with, and they appeared merely to have sought for pieces of copper perhaps of 2 lbs. weight, which they hammered out cold. They seemed not to have known anything of the art of smelting, though that discovery seemed the simplest thing in the world, since they made use of fire to soften the stone, and so to separate

the ore. When they got a large mass they used stone hammers to break off the projections. They had no means of raising the very large masses, nor had they any way of clearing out the water from the bottom. It seemed that the miners had been accustomed constantly to throw back the rubbish into the mine, so that there were now no traces on the surface. These works extended through one hundred or one hundred and fifty miles on the south side of Lake Superior. Sometimes there were cavities of thirty feet, as large as that room; in other cases they made excavations in the bluffs, which were now occupied by porcupines, bears, &c. The stone hammers employed were nothing but boulders of green stone or trap, having a groove round them, into which a wythe was twisted. Some had no such groove, and the mode of swinging them was unknown. Wooden shovels were also employed, and spear heads with a socket. There were, besides, tools like knives and chisels, all made of copper. Timber had also been found with hatchet marks on it. From these marks he judged that the people who worked these mines had a connection with the ancient Mexicans, known as Toltecs or Aztecs. It appeared from the works of Squier and Davis on the Mounds of Ohio, that in those places there had been found tools which would have made marks like those noticed on the timber found in the Superior mining region. Again, the connection between these inhabitants of Ohio, and the miners of Lake Superior seemed to be established from this fact—that in the Lake Superior mines alone were to be found pure copper, having specks of pure silver in them. Now the tools found in Ohio were found to contain these specks of silver, and it was evident that these tools had been hammered out cold, because if they had been melted the silver specks would have disappeared. Then the Spaniards on their arrival found the Mexicans in occupation of fortifications, mounds and pyramids very much like those of Ohio. In this way it appeared to him that a connection was traced between the people of Mexico and the miners of Lake Superior. He considered from a comparison of the trees found upon the tops of the trenches, and of the extent of the works, with the difficulties which the miners must have had in working them, that it must have been 1200 years since the mines were abandoned, and 500 more during which they were occupied. His impression was that the miners resided in a warm country, and came to work these mines in the summer time, taking their produce home in the winter."

INDIAN PAINTINGS AND ANTIQUITIES.

"Professor Wilson read some remarks on the collection of Mr. Paul Kane of Indian paintings and curiosities. He stated that Mr. Kane had had opportunities of seeing Indian customs to an extent possessed by very few, inasmuch as he had travelled for five years through the north-west territory as far as the Russian boundary. The paintings exhibited by Mr. Kane related to the half-breed tribes round the Red River; the Chippewas; the Assineboines; the Blackfeet; and the Crees. He had also portraits of the Wallah-Wallah Indians, and Flat-heads. Among these was the picture of a woman whose head was reduced almost to a disc with the edge presented to the spectator, together with a child belonging to the same woman, going through the process of head flattening. There was also among the curiosities exhibited, a skull of a Flathead, illustrating a subject of very great importance, as bearing on the theories of Dr. Morton as to the type of the American head. There was another portrait of a distinguished Esquimaux, taken from that country where the Esquimaux and the Red Indians meet together, and seemed to blend, instead of showing that marked physical difference which Dr. Morton supposed he had discovered between the Americans and the Esquimaux. There was also a piece of carved ivory from the extreme North-Western region, which struck him as having a close conformity to Mexican sculptures. If there were really this conformity, it would have a great effect in establishing facts with respect to race and migration from north to south. Other objects consisted of pieces of slate cut into a double bas-relief, having that singular admixture of natural objects, with grotesque fancies, such as were seen in Gothic art of the fourteenth century. These objects were Babine pipes. In one of them the artist showed that the had observed the ships, &c., of the Europeans, and had reproduced these objects on his native pipe. This was interesting, as showing how slight were the grounds upon which some generalizations in archaeology were made. There were found in the Ohio mounds many pipes, deposited upon what were considered by Squier and Davis as altars, and the sculptures on these pipes were considered as establishing a certain degree of civilization among the people who built the mounds. Yet these Babine pipes proved that such objects might be produced by races still remaining in a state little removed from the lowest barbarism. He had been induced to make particular inquiries respecting

these Indians, and he had ascertained from Mr. Kane that, though possessing the aesthetic faculty to a high degree, as shown by sculptures, they were in other respects far below other tribes, who were probably quite incapable of any such works of art. He had one other curious remark to make with respect to these Babine Indians, for it appeared that in their customs of sepulture they made a marked difference between the females and the males. The female bodies were all scaffolded, being placed in a canoe and then raised on a stage, while the male bodies were all burned. These facts might serve as useful indications to guide researches into the question of the origin and migrations of the inhabitants of the American continent. He had also been a good deal interested by the information afforded by Mr. Kane with respect to the Flatheads. He desired to know whether their custom of compressing the head into what seemed to be a degraded shape was accompanied by any degradation of intellect. On the contrary it appeared that these people were so superior to their neighbors, as to be capable of making slaves of the surrounding tribes. The flat head was considered a mark of aristocratic origin, and it was therefore prohibited to all slaves to give their children this peculiar formation of the skull."

LAWS OF DESCENT AMONG THE IROQUOIS INDIANS.

Mr. L. H. Morgan read a paper on this subject, describing the singular and complicated method of the descent of property and titles among the North American Indians, the inheritance always passing by the female instead of the male line. "He mentioned several causes, which might be considered to account for this peculiar institution; but one was probably paramount—the desire for independence, and the wish to prevent any family from becoming strong enough to attain to sovereignty—a thing altogether alien to the manners of the hunter state of mankind, and which had never in fact been discovered among the Indian inhabitants of the continent, all of whom were governed by oligarchies maintained, but limited in power by means of this form of inheritance, and by the confederacy of several tribes—a form of polity which existed everywhere in North America.—Mexico might be cited as an exception; but if the institutions of the Mexicans had been thoroughly investigated, it would probably be found that they were identical with those of the Iroquois. Institutions of this kind were remarkably permanent, and it would be very useful, in order to determine ques-

tions in ethnology, to ascertain what other sections had had institutions of the same kind. He had ascertained that they existed in south America, and in parts at least of the islands of the South Pacific."

ETHNOLOGICAL SPECIMENS FROM THE ISLAND OF ANEITEUM.

"Professor Dawson communicated some facts collected by a missionary to this Island, one of the new Hebrides. The people were of the Pupuan or Austral negro race, perhaps with some intermixture of the Polynesian. Their colour a dark copper, their forms undersized and slender, and the hair crisp but round oval in its cross-section, and more smooth on the surface than that of the European, with the internal fibrous structure very strongly developed, and an intense brownish colour. It was trained by the chiefs in slender locks, bound together by vegetable fibre. He mentioned some facts relating to the religious observances of this race, apparently one of the most degraded on the globe. Travellers and even missionaries often did great injustice to barbarous people, by representing that they worshipped objects, which were in fact merely symbols of the spiritual beings to whom they rendered their devotion. Some tribes allied to these had even been represented as having no religious ideas. His friend Mr. Geddie, missionary in this island, had found on the contrary that these islanders believe in a number of spiritual beings called Natmasses, apparently identical with the Nats of Burmah, and with the genii and demi-gods of other mythologies. One of these superior to the rest had drawn up the island from the depths of the ocean when fishing. The others were the special deities of particular places and objects. They were worshipped by means of sacred stones. Some of these are pieces of vesicular trap in the cavities of which the spirits were supposed to reside; others were of rounded, conical and cylindrical forms, due to weathering and beach rolling. Another object of veneration was the decayed trunk of a tree, having a rude resemblance to the human form, and perforated by cavities apparently caused by decay, and in which the spiritual essence was believed to reside. It was unnecessary to point out the essential identity of this religious system with the prevalent mythologies of antiquity, though the rudeness of its appliances corresponded with the low state of civilization of the people.

He concluded by mentioning that these islanders apparently so degraded, had already received a considerable amount of civiliza-

tion; a christian church had been organised among them, and he had a copy of the gospel according to St. John, which was printed from type set by them alone."

BANK NOTE COUNTERFEITS.

"Professor Silliman read a paper on the means adopted for the prevention of counterfeiting Bank Notes.

The first attempt of this kind was made by Mr. Syropian, an American gentleman. His plan was to print his note in colours, between which there was no photographic contrast. He therefore used for the print a blue of a bright colour, and a buff, covering the whole ground, except where there were white spots left for beauty or for the figures representing value. This prevented photographic imitations, and to guard against the anastatic or lithographic arts, he covered the whole face with an oleaginous matter which left no chemical contrast. The great objection to the plan was its want of beauty and its liability to spoil by finger marks and dust upon the oily material. In fact nothing was so good in an artistic point of view as carbon ink on white paper. Mr. Syropian, therefore, next attempted to make use of cycloidal lines drawn over the whole surface of the note, and printed in red, using for the design a black ink, which was fugitive in its character. The patent was for the use of two fugitive inks, the black being more fugitive than the red. He could not praise very highly this second experiment, for on holding one of the notes to the window the black was found to be transparent. A photograph made from this note was fair, not, however, good enough to answer the purpose of a counterfeit; but the great objection to it was that the black could be removed without removing the red, and the red without injury to the black, which opened the way at once to the counterfeiter. This Mr. Silliman illustrated by a great many changes which he had produced on one of these notes. In this difficulty then what was to be done? He held in this hand a note printed on a green tint, produced by sesqui-oxyde of Chromium—an invention which originated in this Province with Mr. Hunt; both colors here were unchangeable by anything which the chemist had at present at his disposal. At least, in practice, neither could be decomposed without destroying the paper as well. The usual plan of altering bills was to wash out the figures and insert others; but here were two colors both alike unmanageable. They were not so beautiful as white and black; but beauty must be sacrificed to safety.

While these notes were protected, therefore, against photographic imitations by the reasons he had mentioned, the fact that both inks were oleaginous, and that they presented no chemical contrast, made it impossible to subject them either to the anastatic or the lithographic process."

THE EXPEDITION IN SEARCH OF FRANKLIN.

On the closing day of the Session, the other sections were almost deserted, owing to the desire of members and others to listen to some remarks on this subject by the celebrated Arctic explorer, Dr. Rae. We postpone the publication of these, hoping to have a full report of them for our next issue.

It only remains, in closing this notice of the Association, to say a few words on the General Meetings and evening entertainments. We have already mentioned the opening meeting. The other general meetings were occupied with routine business, with the exception of one devoted to the address of Prof. Hall, the retiring President. This address, a long and able paper, related chiefly to the generalizations at which its author has arrived as the result of his protracted and successful labours in American geology. Its length and importance preclude any attempt to introduce it here. The closing meeting afforded an opportunity for the expression of much mutual good feeling, well worded on the part of our American guests, and well responded to by the representatives of Canada and Great Britain. We have rarely witnessed anything of the kind in better taste or more agreeable.

During the week of the meeting, private entertainments of the most pleasant and intellectual character abounded. Scientific men are usually good talkers, and easily entertained. A public entertainment was given, on the second evening of the meeting, by the Natural History Society. Its more prominent features were an address by the President of the Society, and a popular amplification of Prof. Hall's address; but its real essence consisted in the free intercourse and mutual introductions of members and their friends. An excursion to the beautiful island of St. Helen occupied Saturday afternoon. A second entertainment was given by the McGill College, in Burnside Hall. As became a collegiate re-union, it was marked by a quiet and scientific tone, but we have reason to know was quite as agreeable to the scien-

PLATE V.

ILLUSTRATIONS OF STERNBERGIA.

Fig 1

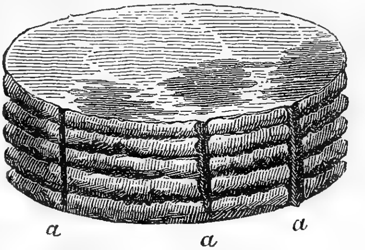


Fig 2

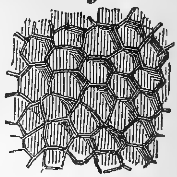


Fig. 1.—Portion of Sternbergia, (nat. size,) (*a*) Remains of Woody Fibre.
Fig. 2.—Transverse Section of one of the Diaphragms of Fig. 1, (magnified.)

Fig 3

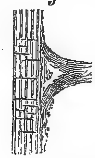


Fig 4

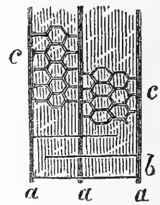


Fig. 3.—Junction of Diaphragm and Wood of Fig. 1, (magnified.)
Fig. 4.—Woody Tissue of Fig. 1, (highly magnified.) (*a*) Cell Walls. (*b*) Medullary Rays. (*c*) Hexagonal Discs.

Fig 5

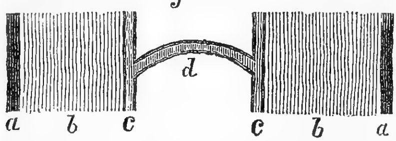


Fig 5, A

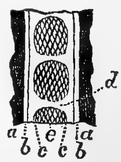


Fig. 5.—Transverse Section of Recent Cecropia peltata, (nat. size.) (*a*) Bark. (*b*) Wood. (*c*) Pith lining Medullary Cavity. (*d*) Diaphragm of Pith.
Fig. 5. *A.*—Section of young branch of a species of Ficus, showing the outer pith tissue and partitions, and the spaces between the latter still filled with the ordinary or inner pith. Reference letters same as Fig. 5. (*e*) Ordinary Pith.

Fig 6

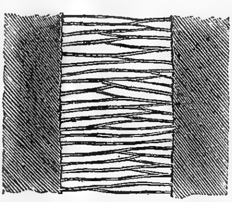


Fig 7

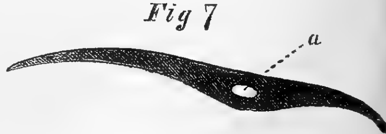


Fig. 6.—Flattened Sternbergia with compressed Bark, (nat. size.)
Fig. 7.—Flattened Trunk, one foot in diameter, with Sternbergia. (*a*) Portion of Sternbergia Cast.

tific strangers as any of the others. The closing evening was distinguished by a civic entertainment, affording an opportunity for a more full display of local oratory and fashion than any of the others. On Thursday, a charming excursion was organized to the rapids of the St. Lawrence and the localities of interest in their vicinity. Tastes differ, and these recreations of Science were as different as tastes; but each was eminently successful, in its own way.

ARTICLE XXV.—*On the Varieties and Mode of Preservation of the Fossils known as Sternbergiæ.* By J. W. DAWSON, F. G. S.

The fossils which have been named Sternbergiæ and sometimes Artisiæ, are usually mere casts in clay or sand, having a transversely wrinkled surface, and sometimes an external coaly coating and traces of internal coaly partitions. They are found in the coal formation rocks of most countries, and very abundantly in those of Nova Scotia. Until the recent discoveries of Corda and Williamson, they were objects of curious and varied conjecture to geologists and botanists, and were supposed to indicate some very extraordinary and anomalous vegetable structure. They are now known to be casts of the piths or internal medullary cavities of trees, and the genera to which some of them belong have been pointed out. Many interesting truths with respect to them, both in their geological and botanical relations, still, however, remain to be developed; and in the present paper I propose to offer some further contributions toward their history, and the geological inferences deducible from it.

In a paper communicated to the Geological Society of London, in 1846, to which Professor Williamson, in his able memoir in the Manchester Transactions,* assigns the credit of first suggesting that connection between these curious fossils and the conifers, which he has so successfully worked out, I stated my belief that those specimens of Sternbergiæ which occur with only thin smooth coatings of coal, might have belonged to rush-like endogens; while those to which fragments of fossil wood were attached, presented structures resembling those of conifers. These last were not, however, so well preserved as to justify me in speaking very positively as to their coniferous affinities. They

* Vol. ix., 1851.

were also comparatively rare; and I was unable to understand how casts of the pith of conifers could assume the appearance of the naked or thinly coated Sternbergiæ. Additional specimens affording well-preserved coniferous tissue, have removed these doubts, and in connection with others in a less perfect state of preservation, have enabled me more fully to comprehend the homologies of this curious structure, and the manner in which specimens of it have been preserved independently of the wood.

My most perfect specimen is one from the coal field of Pictou, (Fig. 1.) It is cylindrical but somewhat flattened, being one inch two tenths in its least diameter, and one inch and seven tenths in its greatest. The diaphragms or transverse partitions appear to have been continuous, though now somewhat broken. They are rather less than one tenth of an inch apart, and are more regular than is usual in these fossils. The outer surface of the pith, except where covered by the remains of the wood, is marked by strong wrinkles, corresponding to the diaphragms. The little transverse ridges are in part coated with a smooth tissue similar to that of the diaphragms, and of nearly the same thickness.

When traced around the circumference or toward the centre, the partitions sometimes coalesce and become double, and there is a tendency to the alternation of wider and narrower wrinkles on the surface. In these characters and in its general external aspect, the specimen perfectly resembles many of the ordinary naked Sternbergiæ.

On microscopic examination the partitions are found to consist of condensed pith, which, from the compression of the cells, must have been of a firm bark-like texture in the recent plant, (Fig. 2 and 3.) The wood attached to the surface, which consists of merely a few small splinters, is distinctly coniferous, with two and three rows of discs on the cell walls, (Fig. 4.) It is not distinguishable from that of *Pinites*, (*Dadoxylon*,) *Brandlingi*, of Witham, or from that of the specimens figured by Professor Williamson. The wood and transverse partitions are perfectly silicified, and of a dark brown colour. The partitions are coated with small colourless crystals of quartz and a little iron pyrites, and the remaining spaces are filled with crystalline laminæ of sulphate of barytes.

Unfortunately this fine specimen does not possess enough of its woody tissue to show the dimensions or age of the trunk or branch which contained this enormous pith. It proves, however,

that the pith itself has not been merely dried and cracked transversely by the elongation of the stem, as appears to be the case in the Butternut, (*Juglans Cinerea,*) and some other modern trees; but that it has been condensed into a firm epidermis-like coating and partitions, apparently less destructible than the woody tissue which invested them. In this specimen the process of condensation has been carried much farther than in that described by Professor Williamson, in which a portion of the unaltered pith remained between the Sternbergia-cast and the wood. It thus more fully explains the possibility of the preservation of such hollow chambered piths, after the disappearance of the wood. It also shows that the coaly coating investing such detached pith casts is not the medullary sheath, properly so called, but the outer part of the condensed pith itself.

The examination of this specimen having convinced me that the structure of Sternbergiæ implies something more than the transverse cracking observed in Juglandaceæ, I proceeded to compare it with other piths, and especially with that of Cecropia Peltata, a West Indian tree, of the natural family Artocarpaceæ, a specimen of which was kindly presented to me by Professor Balfour of Edinburgh, and which I believe has been noticed by Dr. Fleming, in a paper to which I have not had access. This recent stem is two inches in diameter. Its medullary cylinder is three quarters of an inch in diameter, and is lined throughout by a coating of dense whitish pith tissue, one twentieth of an inch in thickness. This condensed pith is of a firm corky texture, and forms a sort of internal bark lining the medullary cavity. Within this the stem is hollow, but is crossed by arched partitions, convex upward, and distant from each other from $\frac{3}{4}$ to $1\frac{1}{4}$ inch. These partitions are of the same white corky tissue with the pith lining the cavity; and on their surfaces, as well as on that of the latter, are small patches of brownish large-celled pith, being the remains of that which has disappeared from the intervening spaces. Each partition corresponds with the upper margin of one of the large triangular leaf scars, arranged in quincuncial order on the surface of the stem. (Fig. 5.)

Inferring from these appearances that this plant contains two distinct kinds of pith tissue, differing in duration and probably in function, I obtained, for comparison, specimens of living plants of this and allied families. In some of these, and especially in a species labelled "Ficus Imperialis," from Ja-

maica, I found the same structure; and in the young branches, before the central part of the pith was broken up, it was evident that the tissue was of two distinct kinds—one forming the outer coating and transverse partitions opposite the insertions of the leaves, and retaining its vitality for several years at least; the other occupying the intervening spaces or internodes, of looser texture, speedily drying up, and ultimately disappearing, (Fig. 5, A.)

Another variety of the Sternbergia-like pith structure appears in a rapidly growing exogenous tree with opposite leaves, cultivated here, and I believe a species of Paullinia. In this trunk there are thick nodal partitions, and the intervening spaces are hollow and lined with firm corky pith, with its superficial portion condensed into a sort of epidermis, and marked with transverse wrinkles; a cast of which would resemble those Sternbergiæ which have merely wrinkles without diaphragms.

The trunks above noticed are of rapid growth, and have large leaves; and it is probable that the more permanent pith tissue of the medullary lining and partitions, serves to equalize the distribution of the juices of the stem, which might otherwise be endangered by the tearing of the ordinary pith in the rapid elongation of the internodes. A similar structure has evidently existed in the coal formation conifers of the genus Dadoxylon, and possibly they also were of rapid growth, and furnished with very large or abundant leaves.

I have no means of ascertaining to what extent this structure may characterise certain botanical families, nor what gradations it may present, between the mere transverse cracking observed in the trunks of the Butternut and other Juglandaceæ, and the perfect partitions developed in Cecropia. Prof. Gray states that the transverse pith structure is characteristic of the North American trees of the genus Juglans, but wanting in the closely allied genus Carya—a parallel case with its apparent restriction to one genus, or perhaps species, of extinct conifers. It is quite possible that some of the more rapidly growing and thicker-branched species of southern conifers, still present similar structures. The axes of cones also deserve study in this respect, since I have observed that the pith of the cone of Pinus Strobus shows, though obscurely, a tendency to the formation of transverse dissepiments.

Applying the facts above stated to the different varieties or species of sternbergia, we must in the first place connect with these fossils such plants as the Pinites Medullaris of Witham. I

have not seen a longitudinal section of this fossil, but should expect it to present a transverse structure of the sternbergia type. The first specimen described by Prof. Williamson represents a second variety, in which the transverse structure is developed in the central part of the pith, but not at the sides. In my Pictou specimen the pith has wholly disappeared, with the exception of the denser outer coating and transverse plates. All these are distinctly coniferous, and the differences that appear may be due merely to age, or more or less rapid growth.

Other specimens of sternbergia want the internal partitions, which may, however, have been removed by decay; and these often retain very imperfect traces, or none, of the investing wood. In the case of those which retain any portion of the wood, sufficient to render probable their coniferous character, the surface-markings are similar in character to those of my Pictou specimen, but often vary greatly in their dimensions, some having fine transverse wrinkles, others having these wide and coarse. Of those specimens which retain no wood, but only a thin coaly investment representing the outer pith, many cannot be distinguished by their superficial markings from those that are known to be coniferous, and they occasionally afford evidence that we must not attach too much importance to the character of their markings. A very instructive specimen of this kind from Ohio, with which I have been favoured by Prof. Newberry, has in a portion of its thicker end very fine transverse wrinkles, and in the remainder of the specimen much coarser wrinkles. This difference marks, perhaps, the various rates of growth in successive seasons, or the change of the character of the pith in older portions of the stem.

I have not been so fortunate as to find any of the Sternbergia or Artisia casts associated with the wood of plants allied to Lepidodendron, as observed by M. Corda. There are, however, in the collection of Prof. Newberry, as well as in my own, specimens which present very considerable differences in their external characters from those of the varieties known to have been coniferous, and which may be the axes of such plants.

The state of preservation of the Sternbergia casts in reference to the woody matter which surrounded them, presents, in a geological point of view, many interesting features. Prof. Williamson's specimen I suppose to be unique in its showing all the tissues of the branch or trunk in a good state of preservation. More

frequently, only fragments of the wood remain, in such a condition as to evidence an advanced state of decay; while the bark-like medullary lining remains. In other specimens the coaly coating investing the cast, sends forth flat expansions on either side, as if the sternbergia had been the mid-rib of a long thick leaf. This appearance, at one time very perplexing to me, I suppose to result from the entire removal of the wood by decay, and the flattening of the bark, so that a perfectly flattened specimen, like that in Fig. 6, may be all that remains of a coniferous branch nearly two inches in diameter. A still greater amount of decay of woody tissue is evidenced by those sternbergia casts which are thinly coated with structureless coal. These must, in many cases, represent trunks and branches which have lost their bark and wood by decay; while the tough, cork-like, chambered pith drifted away to be imbedded in a separate state. This might readily happen with the pith of Cecropia; and perhaps that of these coniferous trees may have been more durable; while the wood, like the sap wood of many modern pines, may have been susceptible of rapid decay, and liable, when exposed to alternate moisture and dryness, to break up into those rectangular blocks, which are seen in the decaying trunks of modern conifers, and are so abundantly scattered over the surfaces of coal and its associated beds in the form of mineral charcoal.

Some specimens of sternbergia appear to show that they have existed in the interior of trunks of considerable size. The best instance of this that I have found is that represented in Fig. 7, from the South Joggins, and which appears to show the remains of a tree a foot in diameter, now flattened and converted into coal, but retaining a distinct cast of a wrinkled sternbergia pith.

Are we to infer from these facts that the wood of the trees of the genus Dadoxylon was necessarily of a lax and perishable texture. It's structure, and the occurrence of the heart wood of huge trunks of similar character in a perfectly mineralized condition, would lead to a different conclusion; and I suspect that we should rather regard the mode of occurrence of sternbergia as a caution against the too general inference from the state of preservation of trees of the coal formation, that their tissues were very destructible, and that the beds of coal must consist of such perishable materials. The coniferous character of the sternbergiæ, in connection with their state of preservation, seems to strengthen a conclusion at which I have been arriving

from microscopic and field examinations of the coal and carbonaceous shales, that the thickest beds of coal, at least in Eastern America consist in great part of the flattened bark of coniferous, sigillaroid and lepidodendroid trees, the wood of which has perished by slow decay, or appears only in the state of fragments and films of mineral charcoal. This is a view, however, on which I do not now wish to insist, until I have further opportunities of confirming it by observation.

The most abundant locality of sternbergia with which I am acquainted, occurs in the neighbourhood of the town of Pictou, immediately below the bed of erect calamites described in the Journal of the Geological Society (Vol. 7, p. 194). The fossils are found in interrupted beds of very coarse sandstone, with calcareous concretions, imbedded in a thick reddish brown sandstone. These gray patches are full of well preserved calamites, which have either grown upon them, or have been drifted in clumps with their roots entire. The appearances suggest the idea of patches of gray sand rising from a bottom of red mud, with clumps of growing calamites which arrested quantities of drift plants, consisting principally of sternbergia and fragments of much decayed wood and bark, now in the state of coaly matter too much penetrated by iron pyrites to show its structure distinctly. We thus probably have the fresh growing calamites, entombed along with the debris of the old decaying conifers of some neighbouring shore; furnishing an illustration of the truth that the most ephemeral and perishable forms may be fossilized and preserved, contemporaneously with the decay of the most durable tissues. The rush of a single summer may be preserved with its minutest striae unharmed, when the giant pine of centuries has crumbled into mould. It is so now, and it was so equally in the carboniferous period.

ARTICLE XXVI.—*On Parthenogenesis of Animals and Plants.*

By BERTHOLD SEEMANN, Ph. D., F. L. S.

(Read before the American Association for the Advancement of Science at Montreal, August 14, 1857.)

One of the most paradoxical questions lately brought before the tribunal of scientific opinion is that of the Parthenogenesis of Animals and Plants; and in venturing to submit it to this meeting

I trust to be the means of directing the attention of American Naturalists, in an increased degree, to this interesting subject, and induce them to co-operate with the leading physiologists of Europe, in lifting the thick veil of mystery still hanging over some portions of it.

The belief in a Parthenogenis or Lucina sine concubitu is by no means of recent growth, but has arrested the attention of mankind since the earliest ages. In diving into the writings of the Classics and studying the mythology of the Greeks, it will be found that, more than once, females are spoken of, who, in a state of absolute virginity, produced offsprings endowed with all the best qualities of our species. And in searching the pages of ancient naturalists of a subsequent period, the subject of a Lucina sine concubitu frequently meets our eye. These statements are sufficient to show the high antiquity of the belief in a Parthenogenesis; but the observations upon which they were founded, are not of such a nature as to exclude the possibility of a subjective deception; and, for the purposes of modern science, they have no other value, than to point out where productive experiments and observations might be made with advantage.

It is different with the publications that in more recent times have been forced upon our attention, and which, having been made with all the caution, circumspection and accuracy demanded by modern criticism, have in the opinion of many eminent naturalists, completelyestablished the fact, that there exist occasionally individual females of both animals and plants, which in a state of virginity are able to propagate in a sexual manner their respective species. We have no modern observations proving the existence of a Lucina sine concubitu in any of the higher animals, —at least I am not aware of any,—but few are inclined to doubt that Professor von Siebold's works, (the English version by Mr. W. S. Dallas.) "On Parthenogenesis in Moths and Bees," have set this question entirely at rest as regard Insects. It is well known that Professor Richard Owen, applied the term Parthenogenesis, some years ago, to the non-sexual reproduction observable in the genus Aphis, but that process being merely one of gemmation, a budding process, equivalent to what we see in the sprouting of a plant, it is now generally rejected, and Siebold and others always understand by Parthenogenesis the Lucina sine concubitu of ancient Naturalists, and, therefore, lay great stress upon the distinction of true Parthenogenesis and alterna-

tion of generation. Siebold by carefully investigating the observations on Parthenogenesis in Insects, made by former naturalists, arrived at the conclusion that these observers were not sufficiently guarded against possible deceptions, and that entymologists had better reject them as inconclusive. He then shows that a true Parthenogenesis does undoubtedly exist in Psyche Helix, Solenobia clathrella, and lichenella, in Bombyx Mori, and Apis mellifica, (the Honey-bee,) but is of opinion that it occurs among insects in a much greater degree than we are at present able to prove. He places in this cathegory the observations of Leon Dufour, that he never was able to obtain a male Diplolepis gallæ tinctoriæ, and alludes to the statement of Hartig, who examined 9,000 to 10,000 individuals of Cynips divisa, and about 4000 of Cynips folii, without even finding among them a single male. The peculiar kind of reproduction observable in the lower Crustaceæ, which some have attempted to explain as alternation of generation or gemmation, may prove on closer investigation to be a true Parthenogenesis. Amongst the Moluscs there are also certain phenomena, which may possibly be explained as phases of a true Parthenogenesis. These allusions sufficiently show that the catalogue of reproduction in animals by means of Parthenogenesis, may look forward to considerable additions; whilst the doctrine hitherto generally received, that the development of the ovum could take place solely under the direct influence of the male principle, has received a shock, from which it is not likely to recover.

In the vegetable kingdom, authentic proofs of the existence of a Parthenogenesis are much more abundant than they are in the animal. Spallanzani, seems to have been the first who, towards the close of last century, pointed out that the female hemp did produce ripe seeds without the aid of pollen; but his statement, though confirmed by the experiments of Bernhardi, met with so much opposition that it could not obtain the acknowledgment due to it; and it is only the recent observations of Naudin in Paris, which, by confirming it still more, have at last vindicated for it the character of an accurate and strictly correct observation. Nor is it to be wondered at, that a fact, opposed to so many theories looked upon as true laws of nature, should have been received with the greatest distrust, and been, ex-cathedra, absolutely denied. That subjective deception should somewhere have taken place was a thought that readily suggested itself, as a

plausible excuse for disbelieving so astounding a fact. How easy for polygamous flowers to be hidden among the female ones! (as Mr. Masters has shown them to exist occasionally in the dioicious hop-plant)! How easy for pollen to be wafted to the stigmas! These and others were the objections of the unbelievers in the new discovery. To this must be added that the experiments of Koelreuter on hybrids, placed the sexuality of plants on a firmer footing than it formerly enjoyed, and that the concession that a dioicious plant could, under certain circumstances, develope its ovula without the aid of pollen, was looked upon as an absolute negation of sexuality.

The polemic on this subject was continued for many a year, but for the want of new observations began also to slacken, when on the 18th of June, 1839, Mr. John Smith, Curator of the Royal Botanic Gardens at Kew, announced before the Linnean Society of London that there existed in the Royal Gardens a female specimen of a Euphorbiaceous plant, Cælebogyne ilicifolia, J. Smith, from New Holland, which annually produced ripe seeds without the aid of pollen. Robert Brown Lindley, the two Hookers, myself and others subjected the Cœlebogyne to strict and repeated examinations but the result invariably was a confirmation of the case as stated by Smith; the Parthenogenesis of this plant was therefore generally accepted by the public of England, but on the Continent of Europe it was rejected as unworthy of credit, as the observations of Treseinus on Datisca cannabina, of Lecog on Spinacia oleracea of Tenore, on Pistacia narbonensis, (confirmed by Bocconi on this and other species of Pistacia), and of Ramisch on Mercurialis annua. All these observations were regarded as mere delusions, of which science ought to be purged as speedily and completely as possible; a fact which can take us the less by surprise when we reflect that the doctrine so ably and long maintained by the Horkelian school that the pollen contains the true origin of the embryo and that the ovulum is merely matrix—has only very recently become untenable through the experiments and observations of Hofmeister, Radlkofer and others.

A history of the embryo more in accordance with nature has opened a new and enlarged field for the Parthenogenesis question, and it is gratifying to find that it has already received the attention of various able observers; amongst others I mention Professor Alexander Braun, of Berlin, who favoured the last meeting of the German Naturalists and Physcians, at Vienna, with his

observations on the Parthenogenesis of Chara crinita, a plant of which no males have ever been found in Germany, though all the females are bearing fruit in abundance. Of the utmost importance is a paper by Naudin, published first by the French Academy, and translated by me into English and German; in which will be found not only a confirmation of the observations of Ramish on Mercurialis annua, but also of those of Spallanzani and Bernhardi on Cannabis sativa, and some new observations on Bryonia dioica.

It had been mentioned by Wenderoth and others that the monœcious Ricinus communis, the Castor Oil plant, produced ripe seed without the aid of pollen; but the direct observations of Naudin show that such is not the case, and that so far from exhibiting any tendency towards Parthenogenesis, all the female flowers fell off the moment the male ones were removed; a similar effect was produced on Esbalium elaterium, another monœcious plant, all the female flowers of which faded after the male ones of the same specimen were taken off; observations which justify us in considering as doubtful the existence of a Parthenogensis in monœcious plants, but has established it in *nine* dioicious ones belonging to seven different natural orders: Chara crinita, Cannabis sativa Spinasia oleracea, Coelebogyne ilicifolia, Mercurialis annua, Pistacia narbonensis, and another species, Bryonia dioica, Datisca cannabina.

How this fact will clash with the existing theories on the origin and formation of the embryo, I will not attempt to discuss. Various explanations will, no doubt, be attempted, but the most common of all, and one that has already been promulgated, that of looking upon this reproduction as a kind of gemmation, must be rejected; for the seedlings raised from the ovula developed without the aid of pollen, are in most cases in which observations have been made, of both the female as well as the male sex; if they were always females, like the mother-plant, then the gemmation theory would have something to recommend it; but as the case stands it must be given up as untenable.

The existence of a Parthenogenesis in animals and plants throws more light upon the history of the embryo than the most able and valued physiological researches could possibly do; it shows more clearly than the most lucid explanation, that the origin of the embryo has not to be looked for in the pollen of plants, or the semen of animals, but in the ovula and ova themselves. And it is in this hint, science recognizes the real practical utility of this

great question. That the Parthenogenesis occupies an important office in the economy of nature we can already perceive, but how it comes to pass that the ova and ovula are developed without the aid of the male principle, and what means are employed to make a sexual reproduction, under such anomalous circumstances, possible, is one of those riddles, the solution of which is reserved for future investigation.

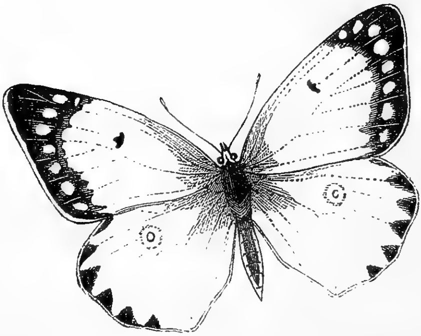
ART. XXVII.—*Description of four Species of Canadian Butterflies.*

Having in our last number expressed an opinion that *P. troilus* was probably an inhabitant of the more southern portions of these Provinces, we were much gratified by receiving a specimen of that species from D. W. Beadle, Esq., of St. Catherines, Canada West. As it is therefore now proved to be a Canadian species, we subjoin a figure and description of it. We shall be greatly obliged if other entomologists follow Mr. Beadle's example, and forward us specimens of such species as may come under their notice, and which we may overlook in the course of our future papers on the Canadian Lepidoptera, together with such information regarding their larvæ, pupæ, food-plants, habitats, seasons, &c., as our correspondents can furnish, and if required we shall be happy to return the specimens, and defray the cost of conveyance. We would also be glad of any useful and accurate observations on the Natural History of those species which we describe, and we especially desire notices of their occurrence in different localities, and whether common or rare. If Canadian Lepidopterists will respond to this appeal, we shall then have data upon which to found a more precise knowledge of the distribution of the various species; this is at present very vague, such words as North America, Canada, United States, &c., being employed in most scientific works to indicate the localities. A catalogue of all the Canadian Lepidoptera is a great desideratum, and numerous zealous observers, in different parts of the country, willing to communicate their observations, are the only means by which we can ever hope to arrive at such a much-to-be-wished for result.

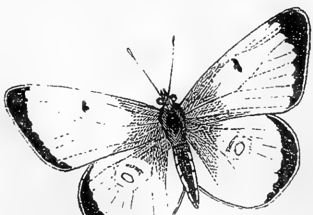
Hitherto we have given figures of each of the species, but in future we shall engrave only one in each genus, except when circumstances render it advisable to figure more, and we shall

PLATE IV.

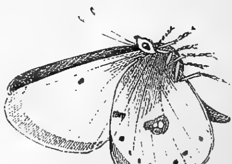
1



2 *a*



2 *b*



2 *c*

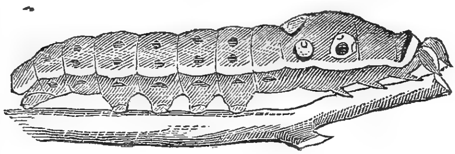
1 Papilio Troilus. 2 *a* Colias Philodice, (female).
2 *b* ——————(male).
2 *c* ——————(underside).

endeavor to get through all the diurnal lepidoptera as speedily as possible. We shall frequently include species which inhabit New York and other Northern States, and which are likely to occur in Canada. As we know of no work exclusively devoted to Canadian species, we are compelled to adopt this course, as otherwise many Butterflies would be omitted, which doubtless inhabit those portions of this country with which we are unacquainted. We hope our correspondents will be able to set at rest any doubts respecting some, if not all such species, by sending us specimens, and all necessary information regarding them.

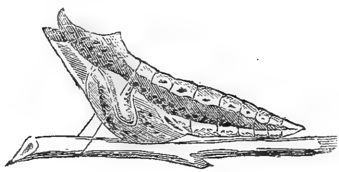
GENUS PAPILIO. (*Continued.*)

Species 3.—Papilio Troilus. The Laurel Swallow-Tail.

Plate iv., fig. 1.



a.



b.

a the Caterpillar. *b* the Chrysalis.

Papilio Troilus, Linnæus, Mus. Lud. Ulric. p. 187, n. 6, Holmiæ 1764. Syst. Nat. 11, p. 746, n. 6, Holmiæ 1765–67.

Papilio Troilus, Fabricius, Syst. Entom., p. 444, n. 7, Flensburgi 1775. Sp. Ins., t. 11, p. 3, n. 9. Hamburgi 1781 &c.

Papilio Troilus, Cramer, Pap. xviii, p. 25, pl. ccvii., fig. A. B. C. Utretcht 1779.

Papilio Troilus, Drury, Ins. 1, tab. 11, fig. 3–5. London 1770–1775.

Papilio Troilus, Godart, Encyclop, Meth. Ins., t. ix. pars 1, p. 62, n. 97, Paris 1819–1821.

Papilio Troilus, Boisduval and Leconte, Ico., &c., des Lépidopterès, &c., t. 1, p. 26, pl. 10. Paris, 1833.

Papilio Ilioneus, Smith and Abbott, Nat. Hist. of the Lepidopt. of Georgia, vol. 1, p. 3, tab. 11. London, 1798.

This species is about the size of P. asterias. Upper side, the wings denticulated, black, with the notches yellow; the anterior wings have on their hind margin a row of six or seven pale yellow spots, which gradually increase in size, from the costa to the inner margin. They have beyond this a spotted band of four or five small and obscure spots placed in a line, and formed of greyish atoms. The posterior wings have a marginal series of seven lunules, the first of which is orange, whilst the other six are of a greenish or bluish grey. Inside these marginal lunules is a broad bluish grey band, divided by the nervures; the lunule of the anal angle is triangular, orange on its inner margin, and greenish grey on its outer. The tail is black, very short, and a little swollen at its extremity. Under side, the wings brownish black at the base. Anterior wings, with the spots of the upper side much better defined, so that they here form two spotted bands; they have also two triangular yellow spots which are placed beyond the others. Posterior wings with two bands, each formed of six orange lunules, a little tinged with yellow on their edges. The anal spot fulvous, only tinged with grey on its outer edge. Between these two spotted bands there are seven glossy blue lunules, the third of which is partly covered by a verticle oblong spot, generally of a greenish grey. The body is black with some reddish dots on the front of the thorax, and a series of yellow spots on each side. The female differs from the male in the following particulars: the anterior wings are generally destitute of the marginal row of yellow spots, the second row being seldom or never indicated by any greyish atoms; the posterior wings have above the marginal lunules a sort of band badly defined, rather broad, and formed of shining blue atoms, whilst in the male this band is better defined, and of a bluish or greenish grey. The under side differs but little.

The caterpillar is green, with a yellow marginal band, which mixes itself a little with the green color. It has upon the sides two rows of blue dots, and upon the fourth segment two flesh colored spots, upon the third segment a flesh colored eye spot with a deep blue ocellus, and upon the first a black collar. The under side of the body and of the head are of a flesh-colour, a little tinged with ferruginous. All the feet are ferruginous, but at the

base of the membraneous ones is a row of seven blue dots. It feeds on sassafras, (*Laurus sassafras*) and Mr. Beadle has observed it on spice wood, (*Laurus benzoin*). It also feeds on many other species of Laurel.

The chrysalis is a little gibbous, of a pale ferruginous colour, with stripes of a darker tint.

The larvæ which are found in autumn change to pupæ before the winter, and produce the imago at the beginning of the following summer; the others are hatched from the end of May all through the month of June and beginning of July.

This fine butterfly is very easily caught. It generally flies around the laurels, and loves to bask on the fragrant blossoms. It is common in Georgia and Virginia, and is found in the island of Jamaica. It is included in Dr. Harris' List of Lepidoptera inhabiting Massachusetts, and as before mentioned we have received it from St. Catherines, Canada West.

We now come to the second division of the Papilionidæ.

Sub-Family II. Pieridi.

Anal edge of the hind wings not concave, but grooved or formed into a gutter to receive the abdomen; the anterior tibiæ do not possess a spur in the middle, and the tarsal ungues are one or two dentate.

The caterpillers are not furnished with a nuchal fork. They are slightly pubescent, and rather slender at each end of the body.

It contains many genera, of which we believe only two occur in Canada, viz: *colias* and *pieris*. We do not know whether any species of the beautiful genera, *aporia*, *xanthidia*, *gonepteryx* and *callidryas*, which inhabit the Southern and middle, and the Southern parts of the Northern States, are to be met with any where in Canada, but we hope to learn that we may include some of them in our fauna.

Genus I. Colias.

Palpi short, much compressed, fringed with short and close hairs, the last joint much shorter than the preceding; autennæ straight, short, terminated by an obtuse gradually formed club

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By some authors *Gonepteryx* and *Colias* are separated into a third sub-family called *Rhodoceridi*, but for the sake of simplicity we have adhered to the more general arrangement which includes them amongst the Pieridi.

which occupies about a fourth of their length, the head has no frontal tuft; forewings sub-triangular, and the posterior rounded; the discoidal cell of the hind wings closed; thorax thick; body shorter than the wings; tarsal ungues bifid; fore legs alike in both sexes. Their flight is very rapid, and they are difficult to capture. The caterpillars naked, elongate, cylindric, very finely setose and tubercled. The chrysalides rather short, sub-angular, gibbous, slightly beaked in front, attached by the tail, and by a girth behind the thorax.

The larvæ feed on leguminous plants.

This is one of the most natural genera of diurnal lepidoptera; the color is always some shade of yellow or orange, more or less bright, and frequently tinged with green. All have a portion of the wings marked with black; the forewings also exhibit a black discoidal spot, and the posterior a central spot, which is orange above, and generally silvery beneath. The palpi and antennæ are always reddish or rosy.

The general resemblance between the species and some being extremely subject to variation, has led to much confusion in their synonomy. The species are not very numerous, and none of them, even of the exotic kinds, beyond the middle size. This genus is found in all the temperate parts of the globe, but they are not known to inhabit the equatorial regions of the two continents. All those which are known come from Europe, Siberia, Cape of Good Hope, Barbary, North America, Mexico and New Holland. Six or seven species inhabit North America, of which two are found in Canada, viz:—*C. edusa* and *Philodice.* We also describe a third, *C. chrysotheme* which occurs in the State of New York. Two or three species inhabit Labrador and the Hudson's Bay Territories, and the remaining one the Southern States.

Species 1.—Colias Edusa. The Clouded Yellow.

Colias Edusa, Boisduval and Leconte, Ico. &c., des Lépidopteris, &c., de l'Amerique Sept. t. 1, p. 59. Paris, 1833.

Colias Edusa, Duncan, Brit. Butterflies, p. 103, pl. v, fig. 2. Edinburgh, 1835.

Colias Edusa, Kirby, Fauna Bor. Amer., (Insects) p. 287. Norwich, 1837.

Colias Edusa, Westwood and Humphrey, Brit. Butterflies, p. 15, pl. 11, fig. 1–4. London, 1841.

Papilio Edusa, Fabricius, Mant. Ins., t. 11, p. 23, n. 240. Hafniœ, 1787, &c.

Papilio Edusa, Borkhausen, Europ. Schmett, pars i, p. 119 et 254, n. 3, pars ii, n. 213, Frankfort, 1788–1795.

Papilio Hyale, Cramer, Pap. p. 119, pl. cccii, fig. E. H. Utretcht, 1781.

Le Souci, Ernst, Pap. d'Europe, vol. ii, p. 226, pl. liv, n. 111, A. D. Paris, 1780.

VARIETIES.

Papilio Helice, var Hubner, Pap. tab. lxxxvii, fig. 440–441.

Colias Myrmidone, Hubner, Europ. Schmett, tas. lxxxvi., fig. 432, 435.

Colias Myrmidone, West, and Hump Brit. Butterflies, 130, t. 42, f. 1–3.

Colias Chrysotheme, Step. Haust, 1, 11, t. 2, f. 1, 2.

Colias Aurora, Meig. Schmett, 1, 26, 2, t. viii, f. 1.

Also described by a very large number of other authors.

Male;—Antennæ, rose-colored, with the club somewhat embrowned. Upper side; anterior wings, deep orange or saffron colour, with a broad, deep blackish brown margin, a little indented internally with the nervures which are finely but distinctly marked with yellow, and divide the black band, the fringe rose-colour; a black oblong spot marks the disk nearer the costa than the inner margin; costa, paler than the rest of the wing. Posterior wings shaded with green, and on each a round deep orange discoidal spot; the margin is also deep blackish brown, the brown colour terminating in a point short of the anal angle, which is paler than the rest of the wing. Under side; anterior wings paler than on the upper side, and all that part of the wing corresponding to the border, greenish yellow, seperated from the ground colour by a row of minute spots about six in number, increasing in size as they approach the inner margin, and placed parrallel to the hind margin, the three first very indistinct and ferruginous, the other three black. The black discoidal sub-marginal spot has a minute white pupil, and there are also two small ferruginous spots on the costa near the tip. Posterior wings, entirely pale yellow, in the centre is a compound eyelet, the exterior circle of which is composed of ferruginous scattered scales, which to form the iris are more condensed, and the two pupils, of which the outer one is the largest, are silvery. They have also a curved row of indistinct ferruginous spots placed parallel to the hind margin, and at the base a spot of rose-colour; the abdomen is greenish yellow, with the back black: thorax covered with rosy hairs; expansion of the

wings 2 to 2½ inches. The female differs from the male in having the black marginal band of the anterior wings broader, more deeply dentated internally, and divided by a series of large greenish yellow spots.

Some varieties of the male have only one pupil to the eyelet on the posterior wings, and are smaller than that described. Examples of the female sometimes occur, in which the parts usually yellow are greenish white, a circumstance which has led some authors to describe it as distinct under the name of *Helice.* American specimens differ but slightly from European, but are not of quite so deep a tint as the latter.

The caterpillar is green, with a lateral stripe varied with white and yellow, and with an orange dot on each segment. It feeds (in Europe) on *medicago lupulina*, *cytisus austriacus*, various species of *trifolium* and other leguminous plants.

The chrysalis is green, with a lateral yellow line, and several ferruginous dots.

This handsome species appears in spring, and a second time in autumn. It is not a common species in this country. We took a very fine female on Montreal Mountain, September 10th, 1856. It was flying in a very sluggish manner, and we caught it under a hat. Boisduval says it is found in Europe, Egypt, the coast of Barbary, Nepaul, Cachemere, Siberia and North America. In England, it occurs in the southern counties in considerable plenty, in certain years, while in others, scarcely an example is to be met with. It seems to prefer the vicinity of the sea, having been found more copiously along the south-eastern coast, particularly in the neighborhood of Dover than elsewhere.

Species 2.—Colias Chrysotheme. The small clouded yellow.

Colias Chrysotheme, Godart, Encyclop. method. Ins., t. ix, pars 1, p. 103, n. 42. Paris, 1819–1821.

Colias Chrysotheme, Boisduval and Leconte, Ico. &c., des Lépidopterés de l'Amer., Sept. t. 1, p. 63. Paris, 1838.

Papilio Chrysotheme, Hubner, Europ. Schmett, tab. lxxxv, f. 426–428. Augsburg, 1796–1835.

This species resembles Edusa a little, but it is much paler, with the margin browner, divided on the anterior wings by fine yellow nerves; the fore wings have, moreover, the costa broadly yellow. The discoidal spot is narrower, transverse, slightly marked, and edged with a little red. The under side of the anterior wings nearly as in *Edusa* and the allied species, except that the discoidal

spot of the fore wings has the centre rather pupilled with silver The female is much paler than the female cf *Edusa*, and the yellow orange colour only occupies the disk of the fore-wings, the yellow spots which divide the dark margin are larger, more marked, and of a much paler yellow colour.

In Europe this pretty Colias is always smaller than *Edusa*, it is the contrary in North America, where it is rather larger than the latter. Boisduval says that this genus is divisable into two groups, C. Edusa belonging to the first, in which the males are provided with a glandular space or sac at the anterior edge of the hind wings near the base, whilst in the second group, to which C. Chrysotheme belongs, they are destitute of this sac. This species is found in Hungary, Styria, and Southern Russia. According to Boisduval it is more numerous about New York than *Edusa*; it appears in spring and in autumn, the second brood being most numerous. We have never met with a description of the larva or pupa.

Species 3.—Colias Philodice. The clouded sulphur.

Plate iv. fig. 2.—*a*, female; *b*, male; *c*, male underside.

Colias Philodice, Godart, Encyclop. method. Ins., t. ix, pars 1, p. 100, n. 35. Paris, 1819–1821.

Colias Philodice, Boisduval and Leconte, Ico, &c., des Lépidoptéres, &c., de l'Amer. Sept., t. 1, p. 64, pl. xxi, fig. 1, 2, 3. Paris 1833.

Colias Philodice, Emmon's Agri., N. Y. Insects, p. 204, pl. xxxv, fig. 1, 2, 4, 9. Albany, 1854.

Papilio Anthyale, Hubner, Pap. eyot., &c. Augsburg, 1806, &c.

Male, the upper side of the wings sulphur yellow, with a rather broad black border, sinuated internally and drawn to a point on the posterior wings, a little before the anal angle. The anterior wings have besides this an oblong black discoidal spot, and the posterior a pale orange spot about the centre of the wing. Under side, anterior wings fine yellow, very pale on the inner margin, and powdered with blackscales on the costa. The black discoidal submarginal spot has a white pupil, and there is a row of indistinct black spots parallel to the hind margin; posterior wings of a deeper tint than the anterior, with two coalescing, central ocelli having a ferruginous iris and silvery pupil; they have also a curved row of ferruginous spots parallel to the hind margin, a ferruginous spot at the basal angle, and another in the middle of the costal edge; all the wings strongly fringed with

rosy; the body, autennæ, &c., as in other species of the genus. The female differs from the male in the following manner:—General colour slightly paler; the black band of the fore-wings is not so well defined, browner, and interrupted by a series of yellow spots; the corresponding band on the hind wings is almost obsolete, and underneath these wings are of a dirty yellow colour instead of being fineorange as in the male.

The caterpillar is stated to be green, with yellow lines and black dots, and feeds on the various trefoils; we have never seen it.

This butterfly is one of our most abundant species. In September we have seen more than twenty pitched at the same time on a bush of Michaelmas daisy, and in some parts of Canada the fields look almost yellow with their dancing forms. It is fond of pitching in muddy spots on roads, sometimes assembling in such places in considerable numbers. It is much more numerous at Sorel than about Montreal, but is very generally distributed over the whole of North America. It appears at the beginning of June, and having several broods during the season, worn individuals linger on to the end of October, even to the confines of our desolate winter.

Note.—Since writing the above, we have taken near Laprairie a curious variety of the female *Colias Philodice*. It is only about half the usual size, and the ground colour of the wings is dirty white, with scarcely any tinge of yellow. The marginal black band on the anterior wings is very broad, but pale and unbroken by yellow spots. The central discoidal spot on the underside of the posterior wings has three pupils—the third rather indistinct.

MISCELLANEOUS.

Obituary.—In our last number we had the melancholy duty of announcing the death of Mr. W. C. Redfield, the meteorologist; and before another month had elapsed, two more men from the ranks of science, highly esteemed for their excellence of character as well as successful labors, had passed away,—Prof. Bailey of West Point, and Prof. Tuomey of Alabama.

Prof. Bailey had long been failing under a relentless consumption, and finally died on Thursday, the 26th of February last. For many months his voice had been reduced to a whisper; yet

his mind was active, and as late as our last number (March,) we published a contribution to science from him, as the result of his recent microscopic researches. Feebleness of health prevented his being present at the meeting of the American Association at Albany in July 1856; but the Association in view of his high attainments and valuable researches elected him President for the following year,—an honor well merited; for few men in the land have exerted a wider and more beneficial influence on the science of the country.

Prof. Bailey, although a proficient also in chemistry, mineralogy, and botany, had been especially devoted to microscopic research, and with the exception of what Ehrenberg has done, the microscopic geology or "micro-geology" of this country has been mainly worked out by him. His first communication to this Journal, was published in 1837, and although chemical, it indicated that delicacy of manipulation which fitted him for microscopic researches. It related to the use of grasshoppers' legs as a substitute for frogs in galvanic experiments. In volume xxxv. (1839,) commence his papers on fossil Infusoria, which were continued through many of the following volumes, down to the current year, and are too well known and appreciated to require remark at this time. The Continent along its Atlantic and Pacific borders and over its interior has passed under his microscope, and delighted him with many beautiful forms of life which had never before greeted a human eye. And lately, the ocean's bottom in the Atlantic to a depth of 1200 feet, and about the North Pacific to 16000 feet, has devleoped wonderful facts before his investigations. Prof. Bailey has also done a vast deal towards raising the standard of microscope manufacture through his discriminating use of tests, and his influence. His scale for microscopic slides by which the positions of the invisible specimens are exactly noted, is a happy thought well carried out. In these and various other ways, microscopy is vastly indebted to his labors. Mr. Bailey at his death was Professor of Chemistry, Mineralogy and Geology in the U. S. Military Academy at West Point. His life without reproach, his gentleness and modesty, his earnestness for truth rather than self, his untiring energy even when his physical system seemed to be dissolving away from his spirit, make a character that excites love as well as admiration.

Prof. Tuomey.—Prof. M. Tuomey died at Tuscaloosa on the 30th of March last. He had been one of the active geologists of the Southern States, and among them had taken the lead through his researches and publications. In 1844 he was put in charge of the Geological Survey of South Carolina, and four years afterward published his final Report in a large quarto volume. The Report treats of the various crystalline rocks and their metalliferous veins or ores, and dwells at length on the Cretaceous and Tertiary beds which had been with him more special subjects of study. In his survey, he brought out many facts of prominent interest, illustrating important principles in the geology of the continent and the history of seashore deposits.

The state of South Carolina is remarkable geologically for containing nothing of the carboniferous formation (unless metamorphosed ;)excepting the middle secondary red sandstone, which he traced from North Carolina to a distance of four or five miles into South Carolina where it is associated with trap dykes as in the Connecticut valley, there are no stratified rocks, yet observed between the metamorphic bed and the Cretaceous.

Subsequently, Prof. Tuomey was appointed to the Chair of Geology of the university of Alabama at Tuscaloosa and to the charge of the Geological Survey of that State, which positions he held when he died. He has been actively engaged in his explorations during the year past, and both the State and the University have experienced a great loss in his decease. In connection with Dr. F. S. Holmes he has had in hand the publication of a splendid work on the Fossils of South Carolina, which has not been surpassed in the country for the beauty of its palæonto logical illustrations. Geological science is greatly indebted to Prof. Tuomey's zeal and fidelity, and has occasion for mourning that his labors have ceased.—" *Sillimans Journal.*"

Dr. Scoresby, the veteran of Artic enterprise, died at Torquay, England, on the 21st of March last, after a lingering illness.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF OCTOBER, 1857.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29'895	29'902	29'907	36'0	57'0	41'5	'192	'398	'253	'84	'84	'92
2	30'005	30'114	30'214	30'0	57'8	37'2	'177	'376	'199	'95	'79	'85
3	224	139	224	35'0	54'9	42'2	'203	'295	'243	'91	'66	'85
4	114	047	095	36'2	65'0	46'5	'192	'425	'303	'83	'68	'93
5	130	056	29'097	41'2	68'2	50'5	'253	'435	'349	'92	'75	'90
6	29'800	29'656	833	48'1	61'6	51'3	'349	'383	'274	'94	'71	'76
7	800	820	846	44'1	64'0	47'0	'261	'401	'291	'85	'67	'86
8	712	612	681	46'2	68'2	55'7	'303	'445	'394	'92	'65	'88
9	839	828	30'050	39'0	57'9	41'0	'220	'316	'217	'88	'66	'79
10	30'098	30'076	120	36'0	68'0	40'3	'192	'366	'227	'85	'63	'85
11	026	29'989	29'930	37'7	69'0	44'6	'229	'461	'282	'91	'68	'92
12	29'975	846	820	35'8	67'0	57'5	'203	'480	'447	'89	'72	'94
13	800	842	873	37'0	64'0	49'1	'446	'562	'336	'96	'90	'91
14	929	866	893	40'4	61'8	43'3	'253	'456	'272	'91	'84	'91
15	756	542	448	44'0	48'7	46'5	'282	'324	'303	'91	'90	'94
16	308	403	473	46'0	50'0	46'5	'313	'304	'282	'93	'81	'86
17	511	698	819	38'0	48'0	57'0	'200	'225	'219	'79	'64	'91
18	883	30'075	30'117	39'9	50'7	58'6	'196	'246	'226	'76	'65	'90
19	940	29'562	29'571	42'1	50'0	44'6	'203	'341	'282	'91	'89	'90
20	564	512	716	57'0	33'0	32'5	'218	'197	'191	'91	'95	'94
21	974	891	30'047	52'0	37'2	29'1	'191	'182	'152	'91	'76	'88
22	30'131	30'113	173	24'0	44'0	51'1	'091	'241	'171	'63	'79	'89
23	111	29'943	100	31'0	58'0	57'6	'158	'367	'218	'81	'75	'95
24	002	912	29'906	42'0	49'2	42'8	'182	'290	'263	'89	'80	'90
25	29'836	704	684	42'9	46'0	44'0	'263	'303	'292	'61	'93	'95
26	525	454	529	42'6	49'0	45'0	'272	'326	'282	'96	'91	'89
27	680	721	823	34'2	38'6	34'0	'170	'226	'178	'79	'90	'83
28	800	755	800	30'0	32'7	51'7	'160	'187	'175	'86	'89	'87
29	610	658	650	32'1	35'5	33'5	'160	'203	'187	'84	'90	'90
30	631	658	752	33'1	41'0	38'1	'188	'235	'226	'89	'85	'91
31	786	733	774	35'0	44'0	38'2	'203	'261	'226	'91	'85	'91

	Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.		
1	S. W.	S. S. E.	N. by E.	1'87	3'57	1'97	0'376	
2	N. by E.	E. N. E.	N. E.	7'50	9'35	1'43		
3	N. E.	N. E.	E. N. E.	11'87	14'42	2'97		
4	N. E. by E.	S. S. W.	W. S. W.	2'54	0'18	0'86		
5	S. W. by S.	W. S. W.	S. W.	0'22	0'05	0'17		
6	W. S. W.	W.	N. W.	0'71	5'05	5'32		
7	W. N. W.	S. S. W.	S. W.	3'62	3'37	3'75		
8	S. W.	S. W. by W.	S. W. by W.	10'98	4'95	8'90		
9	N. E.	W. N. W.	N. E.	4'50	1'20	0'09		
10	E. N. E.	N. E. by E.	E.	0'62	1'98	0'17		
11	E.	S.	S. E. by E.	0'00	2'10	0'06		
12	S.	S. by E.	S. W. by W.	0'12	3'75	0'35		
13	S. W. by W.	S. W. by W.	W. S. W.	0'00	0'10	0'51	0'350	
14	W. S. W.	S. S. E.	N. W. by W.	0'00	0'01	0'00		
15	N. by E.	N. E. by E.	N. E. by E.	5'70	15'03	13'56	0'933	
16	N. E. by E.	N. by E.	N. N. W.	20'56	6'90	5'86	1'176	
17	W.	W.	S. W. by W.	16'82	9'72	6'20		
18	W. S. W.	W.	S. S. E.	4'22	11'77	2'92		
19	S. S. E.	S. S. E.	W. by N.	0'87	9'80	4'67	0'478	
20	W. by S.	W. by S.	W. by N.	6'62	11'76	6'13	0'300	Inapp.
21	W. N. W.	N. W.	W. by N.	23'75	10'70	9'80		
22	N. W. by N.	S. S. W.	S. by E.	3'40	2'01	0'20		
23	S. S. E.	S. S. E.	S. by W.	0'00	0'02	0'50		
24	S. S. E.	S. E.	E.	0'08	0'03	0'06		
25	S. E. by E.	N. E. by E.	N. E. by E.	0'31	1'18	13'75	1'497	
26	N. E. by E.	N. E. by E.	N. N. E.	26'24	23'33	36'80	1'713	
27	N. N. E.	N. E.	N. E.	32'43	10'06	20'61		
28	N. E.	N. E.	N. E. by E.	14'77	14'90	6'22		
29	N. E. by E.	N. E. by E.	N. E. by E.	0'81	0'15	0'35		
30	W. S. W.	S. W. by W.	S. S. W.	0'00	0'06	0'08	Inapp.	
31	S. S. W.	S. E.	S. E. by E.	0'12	0'60	0'32	Inapp.	

	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.
1	C. C. Str. 4.	Str. Ni. 6.	Cirr. St. 8. Thunder.
2	Clear.	Clear.	Clear.
3	"	"	Cirr. 2.
4	"	"	Clear.
5	C. C. Str. 4.	C. C. Str. 8.	C. Str. 10.
6	C. Str. 10.	C. Str. 8.	Clear.
7	Clear.	Clear.	"
8	C. Str. 6.	"	Cir. Cum. 2.
9	Clear.	"	Clear.
10	"	"	"
11	"	"	"
12	Light Cirri.	C. C. Str. 6.	Str. 10.
13	Ni. 10.	Ni. 10.	Clear.
14	Fog.	C. C. Str. 6.	"
15	C. Str. 10.	Ni. 10.	Ni. 10.
16	Ni. 10.	C. Str. 9.	Cum. St. 10.
17	Str. 4.	Clear.	" 4.
18	C. Str. 8.	C. Str. 4.	" 10.
19	Ni. 10.	Ni. 10.	Ni. 10.
20	Ni. 10. Sleet.	C. Str. 8.	C. Str. 8.
21	C. Str. 4.	" 8.	Clear.
22	Clear.	" 2.	Clear.
23	C. St. 4.	Light Cirr. 7.	Clear. Aurora Borealis.
24	Clear.	C. Str. 9.	C. St. 4. " "
25	C. C. Str. 6.	Rain.	Rain.
26	Rain.		C. Str. 9.
27	Str. 8.	C. Str. 9.	C. Str. 10.
28	C. Str. 6.	" 10.	C. Str. 10.
29	" 10.	" 10.	C. Str. 10.
30	" 10.	" 9.	C. Str. 8.
31	" 8.	" 10.	C. Str. 10.

REPORT FOR THE MONTH OF NOVEMBER, 1857.

	Barometer 6 a. m.	2 p. m.	10 p. m.	Temperature 6 a. m.	2 p. m.	10 p. m.	Tension 6 a. m.	2 p. m.	10 p. m.	Humidity 6 a. m.	2p. m.	10 p. m.
1	29'608	29'616	29'601	38'2	44'6	38'3	'226	'223	'226	'91	'75	'91
2	460	381	431	37'1	45'0	35'5	'218	'253	'210	'91	'80	'91
3	484	649	694	36'0	40'4	36'0	'210	'227	'210	'91	'85	'91
4	872	937	30'026	30'1	37'5	27'5	'168	'218	'146	'88	'88	'88
5	954	842	29'697	29'0	40'6	38'7	'161	'210	'234	'89	'79	'92
6	420	472	432	37'0	60'4	48'0	'218	'371	'290	'91	'71	'81
7	652	760	890	40'3	51'0	42'0	'210	'274	'243	'79	'70	'85
8	860	957	939	34'4	38'5	38'2	'203	'226	'246	'91	'91	'99
9	610	553	595	46'0	64'1	55'0	'292	'565	'420	'89	'94	'98
10	784	883	30'009	44'0	44'9	34'1	'289	'241	'178	'96	'79	'83
11	30'002	30'084	187	32'0	40'9	37'3	'191	'210	'199	'93	'79	'83
12	042	29'818	29'725	30'1	35'0	34'1	'160	'203	'195	'86	'90	'89
13	29'654	585	721	33'0	43'0	31'0	'197	'233	'185	'95	'79	'90
14	883	930	30'082	20'0	25'6	20'0	'089	'123	'120	'68	'79	'82
15	30'107	975	000	22'7	34'0	32'5	'127	'204	'197	'88	'89	'94
16	29'998	781	29'650	30'0	37'8	31'1	'177	'218	'185	'95	'90	'96
17	401	297	221	32'8	37'1	34'0	'189	'201	'204	'90	'85	'94
18	158	147	247	32'4	38'4	34'1	'197	'214	'204	'95	'86	'95
19	133	003	010	33'2	47'7	33'6	'204	'271	'204	'93	'80	'92
20	104	140	218	25'4	27'6	26'6	'147	'157	'101	'92	'82	'77
21	212	380	513	23'5	32'1	27'0	'112	'167	'143	'77	'82	'88
22	504	500	797	26'4	38'0	26'6	'146	'173	'135	'88	'70	'83
23	684	244	340	26'4	34'0	33'0	'146	'195	'197	'88	'91	'94
24	484	508	637	16'0	25'6	18'0	'093	'147	'106	'85	'90	'87
25	30'076	30'201	30'300	1'0	13'0	9'7	'043	'068	'079	'84	'67	'86
26	344	291	306	10'1	28'3	25'1	'082	'119	'129	'90	'68	'82
27	197	164	235	23'0	36'0	31'8	'112	'192	'182	'77	'83	'90
28	282	102	229	34'1	37'2	35'2	'199	'199	'203	'91	'83	'91
29	242	277	331	34'6	47'0	33'0	'203	'271	'197	'91	'80	'94
30	198	058	29'967	32'8	42'6	40'9	'199	'243	'253	'93	'85	'92

	Wind 6 a. m.	2 p. m.	10 p. m.	Velocity 6 a. m.	2 p. m.	10 p. m.	Rain	Snow
1	S. W.	S. W. by W.	S. by W.	0'12	4'23	1'63		
2	S. by W.	S. W.	S. by E.	7'35	7'75	0'76	0'416	
3	W. S. W.	W. S. W.	W. by N.	4'65	10'17	2'65		
4	W.	W. by N.	E. N. E.	9'91	2'08	2'12		
5	E. N. E.	N. E. by E.	E. by N.	0'50	5'80	2'22	0'330	
6	S. W.	S. W. by W.	W. S. W.	15'13	8'97	10'05	0'530	
7	W. S. W.	W. S. W.	N. E. by E.	5'22	4'27	0'07		
8	N. E. by E.	N. E. by E.	N. N. E.	19'96	9'80	14'61	1'120	
9	S. E.	S. S. E.	W. S. W.	13'35	4'22	9'37	1'642	
10	W. S. W.	W. S. W.	W. S. W.	4'73	24'85	9'22	0'330	
11	S. W.	S. W.	W. S. W.	10'02	3'91	8'66		
12	S. E. by E.	S. W. by S.	W. S. W.	1'51	1'81	5'20	0'160	
13	W. S. W.	W. S. W.	N. by W.	5'65	4'83	12'82	0'202	
14	N. W.	W. N. W.	W.	2'42	8'50	8'95		
15	W. S. W.	W. S. W.	W. S. W.	7'27	6'42	6'65		
16	W. S. W.	S. E.	S. E.	1'73	1'62	2'27		
17	W. S. W.	W. S. W.	W. S. W.	4'60	2'81	3'00	Inapp.	2'01
18	W. S. W.	S. S. W.	S. S. W.	7'31	4'77	9'10		Inapp.
19	E. by S.	S. E.	W. S. W.	6'42	1'83	23'48		
20	W. S. W.	S. W.	S. W.	15'70	11'68	17'57	0'376	Inapp.
21	W. S. W.	W. S. W.	S. by E.	15'57	11'02	12'67		
22	S. W.	S. W.	W. S. W.	4'30	8'31	7'11		
23	E. N. E.	S. E.	W. S. W.	2'22	3'27	10'73	0'643	Inapp.
24	W. S. W.	S. W. by W.	N. W.	12'83	13'81	7'60		
25	W. N. W.	W.	W. S. W.	17'64	15'82	12'81		
26	W. S. W.	S. W.	S. W.	7'90	7'65	5'20		
27	S. W. by W.	W. S. W.	S. S. W.	14'32	5'45	4'06		
28	S. by W.	W. S. W.	W. S. W.	5'03	8'85	3'55		
29	S. W.	E.	N. E. by E.	0'01	0'50	7'31	Inapp.	
30	N. E. by E.	S. E. by E.	S. S. E.	8'36	4'52	14'76		

	6 a. m.	2. p. m.	10 p. m.
1	C. C. Str. 4.	C. Str. 8.	C. C. St. 8.
2	Cum. Str. 8.	" 6.	C. Str. 4.
3	" 8.	" 6.	" 10.
4	Clear.	C. C. Str. 8.	Clear.
5	C. Str. 10.	C. Str. 4.	Rain, Thunder.
6	" 8.	Clear.	Clear Lightn'g in N.E, at 7 [P. M.
7	Clear.	C. Str. 2.	C. Str. 10.
8	Ni. 10.	Rain.	Rain.
9	Rain.	C. Str. 10.	C. Str. 6.
10	Rain.	" 4.	Clear.
11	Clear.	" 8.	C. Str. 10.
12	C. Str. 9.	Sleet.	Rain.
13	" 6.	C. Str. 8.	C. Str. 6.
14	Clear.	" 4.	" 2.
15	Str. 10.	" 10.	" 10.
16	Cirr. Str. 6.	" 4.	Snow.
17	" 8.	" 10.	C. Str. 8.
18	" 8.	" 2.	" 8.
19	" 10.	" 4.	Sleet.
20	" 4.	" 10.	Clear.
21	C. C. Str. 4.	" 9.	Light Snow. Mock Lunar.
22	C. Str. 10.	" 6.	Cirr. Str. 2.
23	" 10.	" 6.	" 10.
24	" 4.	" 8.	" 4.
25	Clear.	Clear.	Clear.
26	C. C. Str. 4.	C. Str. 10.	C. Str. 9.
27	Clear.	C. C. St. 6.	" 8.
28	C. Str. 4.	C. Str. 8.	" 10.
29	" 10.	Cirr. Str. 2.	Clear.
30	" 9.	C. Str. 8.	C. Str. 10.

REMARKS FOR OCTOBER, 1857.

Barometer. Highest, the 3rd day, 30'224 inches. Lowest, the 16th day, 29'308 ". Monthly Mean, 29'824 inches. Monthly Range, 0'916 ".

Thermometer. Highest, the 8th day, 70°0. Lowest, the 22nd day, 23°6. Monthly Mean, 44°19. Monthly Range, 45°40.

Greatest intensity of the Sun's rays, 98°4.
Lowest point of Terrestrial radiation, 22°1.
Mean of Humidity, 859.

Amount of Evaporation, 3'86 inches.
Rain fell on 10 days, amounting to 6'823 inches; it was raining 90 hours and 56 minutes, and was accompanied by Thunder on 1 day.
Snow fell on one day, the 20th, inappreciable.
Most prevalent wind, N. E. by E. Least prevalent wind, the E.
Most windy day, the 26th day; mean miles per hour, 28'78.
Least windy day, the 14th day; mean miles per hour, 0'03.
The Electrical state of the Atmosphere has indicated feeble intensity.
Ozone was in large quantity.
Aurora Borealis was visible on 2 nights.

REMARKS FOR NOVEMBER, 1857.

Barometer. Highest, the 26th day, 30'344 inches. Lowest, the 19th day, 29'003 ". Monthly Mean, 29'681 inches. Monthly Range, 1'341 ".

Thermometer. Highest, the 9th day, 64°1. Lowest, the 25th day, 1°0. Monthly Mean, 33°69. Monthly Range, 63°1.

Greatest intensity of the Sun's rays, 69°6.
Lowest point of Terrestrial radiation, —1°0.
Mean of Humidity, '871.

Rain fell on 12 days, amounting to 5'749 inches; it was raining 74 hours and 15 minutes, and was accompanied by Thunder on 1 day.
Snow fell on 4 days, amounting to 2'01 inches; it was snowing 12 hours 10 minutes.
Most prevalent wind, W. S. W. Least prevalent wind, E.
Most windy day, the 25th day; mean miles per hour, 22'09.
Least windy day, the 1st day; miles per hour, 1'99.
The Electrical state of the atmosphere has indicated moderate intensity.
Ozone was in rather large quantity.

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ART. XXVIII.—*On Ozone.* BY CHARLES SMALLWOOD, M.D., L.L.D., Professor of Meteorology in the University of McGill College, Montreal, Canada.*

Mr. Chairman,

It would be unbecoming in me as forming a part of the deputation to Albany last year, for the purpose of inviting the Association to meet at this place, were I not to take advantage of the present moment, to greet you, gentlemen Members of the American Association, with a cordial and hearty welcome, and I need scarcely add, that the like sentiment inspires the whole of the inhabitants of this city.

Until the present time, these Annual Meetings have been confined to the United States alone, (although not exclusively American,) and separated only by an imaginary boundary, which has now been removed, for we here meet, united as one family, having one common object in view,—" the Advancement of Science,"

* This and the following paper were read at the Annual Meeting of the American Association for the Advancement of Science, Montreal, August, 1857.

we are treading the same peaceful path of knowledge, we are assembled under the broad, the vast canopy of the American firmament, the gentle breeze that wafts the red cross banner of St. George and Merry England, alike unfurls, the stars and stripes, the emblem of your land of freedom. Long may these two flags entwine in peace, in kindred folds, and may that master-piece of scientific genius, the electric cable, which is at this moment being laid beneath the Atlantic sea, whose waves science has measured with a mighty span, be the peaceful band, that will cement more firmly the destinies of the two great nations of the earth, under the benign and able guidance of your worthy President, and our beloved Queen, and may science, which knows no country, no nation, no language, be rendered more subservient to the happiness and welfare of the whole human family.

A year has now passed since the deputation from this place enjoyed the hospitalities of one of your large cities, the familiar and friendly faces of many we met there, and now present, calls to mind many pleasant recollections, but like all things mundane, we have some cause for sadness, for in the few fleeting moons that have waned since last we met, death has taken from our midst a Redfield, a Bailey, and a Mitchel, each pre-eminent in his department of scientific research, and to science and us, an irreparable loss, and the Association has done itself honor in paying a tribute to their memories; but the midnight lamp of the man of science must grow dim, the experimentalist must for ever quit the busy scenes of his laboratory, the eye of the astronomer must be closed, for the life of the philosopher is but mortal.

It is my intention to lay before the section the results of observations made on the amount of ozone present in the atmosphere. The place of observation is at St. Martin's, about 9 miles due west of Montreal, and is 118 feet above the mean level of the sea; it is situated in the centre nearly of the Isle Jesus, an island surrounded by the branches of the Ottawa, the place of observation is a little more than 3 miles from the river, thus being sufficiently inland, to be removed from any transient vapour or fog, which is often present in the proximity of rivers; it is a flat island, and the whole of the neighborhood is under cultivation.

It is not my purpose to enter into a lengthy detail of the chemical composition of ozone, enough for our present purpose to define it to be, a compound of oxygen, analogous to the per-oxide of hydrogen, or that it is oxygen in an allotropic state, that is

with the capability of immediate and ready action impressed upon it. To Schonbien is awarded the discovery, who, in 1840, applied the term ozone to the peculiar smell which is perceptible during the action of the electrical machine, and also during the decomposition of water by the galvanic apparatus. It was subsequently ascertained that a similar smell is developed by the influence of Phosphorus on moist air, and also by a great many chemical changes, and for some time its existence was recognized by its smell, or odour, alone; but in April, 1848, Schonbien became possessed of another of its characters, viz: its oxidizing principle, and it is this property which it possesses more particularly, when we direct our attention to its presence in the atmosphere, although these oxidizing properties may be common to some other bodies, as nitrous acid, which is said to be generated in the atmosphere by atmospheric electricity.

When largely diffused in the atmosphere, it causes like chlorine (to which it is somewhat allied) very unpleasant sensations, such as difficult respiration, and it acts powerfully on the mucous membrane, it kills small animals very quickly; it is insoluble in water, and oxydizes very quickly all metallic bodies, and it has the power in a large degree, of destroying *miasma* arising from the decomposition of animal and vegetable substances, and Schonbien came to the conclusion, that its formation depended upon the action or formation of atmospheric electricity, and he referred the beneficial effects of thunder storms, to the action of the ozone formed, neutralizing the miasma arising from the decomposition of animal and may be vegetable substances, and it possesses in a powerful degree bleaching properties, and in this it is again analogous to chlorine.

Since Schonbien brought its properties before the scientific world, it has received more or less attention both from the physi cian and the meteorologist.

It has been advanced, that during the presence of cholera and other epidemic disease, its absence was remarked, while on the other hand, when the atmosphere has indicated a great amount present, diseases of the lungs and mucous membrane have been more prevalent, it has been still further stated that its action on the vegetable kingdom is similar in its effects as in the animal economy; the potatoe disease or rot especially, and other diseases in vegetables has, it is said, been caused by either its absence or presence, in too large quantities.

It would far exceed the limits of time alloted to me to enter fully into the progressive steps of the investigation or history of ozone, for it has engaged the attention of physicians in England, and on the continent of Europe, and I am happy to say, that some members of the American Association have devoted considerable attention to it, and I have deemed it of sufficient import, to lay before the section the result of some eight years of investigation, or nearly 6,000 observations. This includes observations during the visitation of the cholera in 1854, and I heartily trust that the Association may, by its influence, extend these observations through the whole of the United States territory, and, as far as practical, throw some light on its action in the animal and vegetable kingdom, and I am sure a subject of so much importance, and which must (if we are to believe the report of some investigators) exert an influence on both the health of animals and of plants, will be at once a sufficient ground for extending such observations, which should be as uniform as possible.

The method of estimating and detecting the amount of ozone, is by what is called the *Ozoneometer*, which is nothing more than slips of paper, wetted with the solution of starch and iodide of potassium; these became blue on exposure, owing to the oxidization of the potassium by the ozone, and the setting free of the iodine, the formula I use, and the one generally adopted is ʒ i of starch boiled in ℥ i of distilled water, and when cold 10 grains of the iodide of potassium is mixed with it, it is quickly spread on paper and dried in the dark, and must be kept in a dry place, and free from light until required; when they are placed in a situation shaded from the sun and rain, these strips are one-half an inch wide, and from three to four inches long. Dr. Moffatt, an eminent English physician, and who has paid much attention to the subject, places his slips of paper in a box, without a bottom, so as to be *excluded* from the light; but so far as my observations go, I have found so little difference in the two methods, that I have continued that of Schonbien's, as I have before stated, and expose the slips of paper to light, but *excluded from the sun and rain.* The amount of ozone present is estimated, in 10ths the deep shade or saturation, being 10, and diminishing in depth of shade to 0.

It has also been asserted that slips of paper placed at high elevations, has exhibited a deeper shade. To test this fact, I exposed slips of prepared paper at an altitude of 80 feet, on the top of a pole or mast, which is used for collecting atmospheric electricity

and as far as my observations go, I could detect no appreciable difference from those exposed 5 feet from the ground, and if I might be permitted to suggest, that to insure uniformity, the elevation of 5 feet might be considered the standard height, and which is at once convenient and far enough removed from the effects of terrestrial radiation or deposit of dew, leaving it o course to observers to adopt at the same time, any other method which might suggest itself, during the observations on this phenomena.

So far I have, as concise as the subject would permit, traced its history, properties and method of observations, and the propriety of so doing may indeed be questionable, before so learned a body; but I have felt that the subject might be new to some present, and with a wish that uniform observations should be made, I deemed it well to state very briefly its prominent character, and in so doing I have thrown myself on your indulgence. I may just state that the colour of the test paper may be brought more fully out, by moistening it with water.

I shall now proceed to give the *section* the results of observations made by these means.

The questions for our investigation, and which naturally arise are these:—What is the effect of the presence of ozone on the meteorological conditions of the atmosphere, as indicated by the instruments most in use?

And, secondly, what influence does its presence or absence exert on the health of animals or vegetables? or does its presence or absence give rise to disease?

1st. What are the *barometric* indications?

The presence of ozone in the atmosphere is accompanied by a low reading of the barometer, which generally continues while the *ozonic* period lasts; this period is accompanied or terminated almost invariably by precipitation in the shape of rain or snow.

Therometer. I have observed the presence of ozone at all temperatures, when the therometer has indicated 20°, (below zero,) and as high as 80°, and in all the intermediate temperatures, and it is generally in larger quantities during a fall of snow than of rain. The *psychometer* is a certain indication of the presence of ozone, for it would appear that a moist state of the atmosphere was necessary for its production or development, for when the difference between the *dry* and *wet* bulb therometer is little, the presence of ozone in considerable quantity is invariably present

but when the difference between the two therometers is considerable, no ozone is appreciable by the *ozoneometer*. This fact and the only one which (as far as my observations here go) is in connexion with the presence or absence of ozone, has led me to compare the presence of ozone with the presence of precipitation in the shape of snow or rain, which gives a remarkable co-incidence. For in and during the past seven years there were 918 days on which rain or snow fell, (this is regardless of the amount or duration,) and during the like period there were 816 days on which ozone was present in a quantity of five-tenths, any amount below that quantity in this estimation is not taken into consideration in the discussion. In the year

1850	there were	106	days of precipitation,	and	110	days	of ozone.
1851	"	123	"	"	135	"	"
1852	"	136	"	"	152	"	"
1853	"	136	"	"	114	"	"
1854	"	133	"	"	73	"	"
1855	"	140	"	"	110	"	"
1856	"	144	"	"	126	"	"

The small amount of ozone in 1854, which was the year of the last visitation of cholera, would tend to favour the opinion that there was a deficiency of ozone in the atmosphere during the prevalence of that epidemic. A deficiency was, however, observed in almost every month of that year, although the number of days on which snow or rain fell were almost equal with the other years, which see the following table, which shews the amount for each year, and for each respective month :—

YEARS.	1851.		1852.		1853.		1854.		1855.		1856.	
	DAYS OF		DAYS OF		DAYS OF		DAYS OF		DAYS OF		DAYS OF	
MONTHS.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.	Precipitation.	Ozone.
January, ...	10	5	14	7	9	11	14	6	12	6	12	14
February, ...	6	7	11	8	11	9	16	6	8	9	9	16
March, ...	11	6	17	11	9	21	17	7	9	6	10	17
April, ...	12	8	10	11	7	12	10	6	14	8	11	20
May, ...	16	14	9	8	16	12	8	7	6	9	13	20
June, ...	12	12	17	18	15	11	10	8	15	12	10	17
July, ...	13	16	11	17	9	4	5	4	7	11	12	18
August, ...	8	15	9	16	13	7	7	3	11	12	15	11
September, ...	11	15	10	16	11	9	11	3	12	11	14	12
October, ...	12	11	17	18	14	5	11	8	18	11	10	8
November, ...	10	13	10	12	14	11	13	11	14	9	15	8
December, ...	11	13	18	14	8	8	12	7	14	6	11	5
Total.	123	135	136	152	136	110	133	73	140	110	144	126

Southerly and easterly *winds* being the point from which our rain or snow generally comes, are for the most part present, during the indications of ozone, while on the contrary northerly or westerly winds, very rarely accompany its development.

In reviewing these observations, there is no condition of the atmosphere appreciable by our instruments, that indicates the presence of ozone except the presence of vapour or humidity.

Schonbien has asserted that a high electrical state of the atmosphere was always present when ozone was developed, and that the amount depended essentially on the amount of atmospheric electricity. From the comparison of nearly 6,000 observations on the electrical state of the atmosphere, and the amount of ozone taken at the same hour, at this place, and carefully compared; I have not found that opinion sustained, neither have I found its amount or presence influenced by the appearance of the *aurora borealis* which has also been said to be the case.

From these observations it would appear that a moist and humid atmosphere was necessary for the development of ozone, and this may account in some measure for its more constant presence and its greater quantity, in proximity to the sea. So far as its effects on the production of disease in plants, especially the potatoe, and to which it has been more especially referred; it is almost certain that one of two causes must have given rise to the lamentable failure in this useful vegetable, either that the soil must have furnished the medium of disease, or the action of the atmosphere upon the leaves and stem of the plant,—the causes which act upon the stem and leaves, involve the action alone of Atmospheric Influences, while those that act through the medium of the soil are more numerous.

In this neighbourhood the disease showed itself after rain followed by a hot Sun, the atmosphere being loaded with moisture or vapour—just the condition essentially proper for indicating the presence of Ozone—the disease was much more extensive on wet and clayey soils than on sandy or dry ones.

It cannot be doubted that an agent so active as ozone, if really present, must exert a great influence on the health of individuals as well as animals and plants, the manner of its production, whether by chemical action or electricity, or magnetism, demands from us further investigation, and these investigations should be carried out with uniformity for the sake of careful comparison—one point should not be overlooked, that is, to mark carefully the amount

of vapour present in the atmosphere, as the intimate connexion between them is too prominent to escape observation.

I have, as you will perceive, offered no theoretical deductions, if, as our continental brethren assert, that it does possess such powerful and wonderful properties, it must be evident that the American Association should at once take up the subject, in a way that we may arrive at important conclusions. I should not be justified in expressing a doubt on the labours of others in this Department of Physical Science, neither do I think it fair to offer any conclusions until our observations are more extended, and it is with this intention that I have brought it before the Association, hoping that between now and our next meeting, we may be able to investigate and compare observations so as to give it a proper place in this department of physical investigation.

ART. XXIX.—*On the Meteorology of the Vicinity of Montreal,* being reduced from Observations taken at St. Martin, Isle Jesus, Canada East, by CHARLES SMALLWOOD, M. D., L.L.D. Professor of Meteorology in the University of McGill College.

Being well aware that many of you are here for the first time in this, our Northern city, and have scanned, and I have no doubt, admired the numerous edifices—those artificial structures erected by the human hand, guided by human skill, and well suited to our wants. I am also aware that many among you have bent your investigations beneath our alluvial and fruitful soil, to contemplate the geology of our rocky formations, and the deposits of bygone ages, the work of that Divine Architect at whose command those bright and countless orbs that spangle in our firmament were brought into existence, and which forms to the astronomer so many objects for his study ;—and I felt it might be interesting to you to know something of our climatology, and it is for this purpose I intend laying before the section some remarks in illustration, reduced from observations taken at St. Martins, nine miles due west of this place, and I shall for this purpose confine my observations to the means reduced from the last septennial period, although the observations on record extend over a much longer period of time.

The geographical co-ordinates of the place are 45° 32' north latitude, and 73° 36' longitude west of Greenwich. The cisterns of the barometers are placed at 118 feet above the level of the sea. The instruments used are standard instruments; the barometric observations are all reduced to the freezing point, (32° F.) and the temperatures are all in Farenheit's scale. The hygrometric observations are reduced by the tables and formula adopted at the Greenwich observatory in England. The receiver of the rain guage is placed 20 feet above the soil. The direction and velocity of the wind is ascertained by a self-registering instrument which indicates its velocity by dots on a paper register in miles linear. The electrical apparatus is provided with a collecting lanthorn which is elevated 80 feet from the ground. The solar and terrestrial radiators are also read in terms of Farenheit's scale. The ozonometer is of Schonbien's construction. The whole of the means are reduced from three daily observations, taken at 6 a.m., 2 p.m., and 10 p.m.; extra hours are also set apart for any unusual phenomena.

Barometer.—The mean heighth of the barometer for this period (7 years) was 29.676 inches, the mean reading for the same septennial period in January was 29.744 inches, February 29,744 inches, March 29,492 inches, April 29,679 inches, May 29,604 inches, June 29,718 inches, July 29,715, inches, August 29,754 inches, September 29,722 inches, October 29,619 inches, November 29,769 inches, December 29.565 inches. The highest reading observed and on record here was on the 8th January 1855, and at 4 p.m. it attained the unusual height of 30.876 inch.; the lowest reading on record was in December also in 1855, and was 28,689 inches, giving an absolute range of 2,187 inches. The mean yearly range for the 7 years was 1,032 inches, and for the months as follows:

	inches.		inches.		inches.
January,	1,550	May,	0,800	September,	0,815
February,	1,131	June,	0,752	October,	0,951
March,	1,145	July,	0,616	November,	1,295
April,	1,090	August,	0,701	December,	1,538

There are two maxima and two minima variations occurring in the barometer in the 24 hours; the maxima variation occurs at between 9 and 10 o'clock a.m., and between 9 and 10 p.m., the minima variations occur at 3 a.m., and 3 p.m.

Thermometer.—The temperature of the air for the same period (7 years) exhibits a yearly mean of 41° 56'. The mean tem-

perature of January was 13° 26', February 13° 31', March 25° 44', April 40° 12', May 55° 70', June 62° 11', July 74° 78', August 61° 21', September 58° 12', October 46° 04', November 31° 49', December 13° 80', the absolute mean range for the same period has been from 90° 9' + to 27° 4' — (below zero) the absolute monthly range was, in

January + 40° 7 to 25° 1—	July + 97° 1 to 47° 8+
February + 41° 1 to 25° 2—	August + 96° 7 to 40° 6+
March + 56° 0 to 6° 7—	September + 91° 2 to 30° 4+
April + 75° 6 to 10° 1+	October + 75° 7 to 23° 8+
May + 86° 6 to 25° 7—	November + 60° 4 to 5° 7+
June + 94° 5 to 40° 5+	December + 42° 1 to 26° 3—

The highest temperature in the shade on record here was 100° 1, and the lowest range was 36° 2′ below zero, giving a climatic range of 136° 3′ degrees ; the hottest month is July, and the coldest month is February ; the warmest part of the day in summer is at 3 p.m., and in the winter season at 2 p.m. ; the coldest part of the day in winter is at a little before sunrise.

The mean yearly temperature of the *dew point* reduced for the same period was 35° 6, and for the different months as follows :—

January	9° 6	July,	65° 0
February	7° 4	August,	53° 1
March,	20° 2	September,	52° 2
April,	34° 6	October,	40° 8
May,	47° 2	November,	26° 1
June,	54° 1	December,	8° 1

The relative degree of humidity for that period saturation being 1·000 was 814, and for the months :—

January,	·869	July,	·744
February,	·808	August,	·765
March,	·835	September,	·809
April,	·812	October,	·821
May,	·774	November,	·824
June,	·770	December,	·832

The *Electric force of Vapour* exhibits a daily maximum at 3 a.m., and a minimum at between 3 and 4 p.m. The summer quarter, which embraces June, July and August, is the dryest quarter; next is the Spring quarter which embraces March, April and May, the Autumnal and Winter Quarters are the most humid. Complete saturation does not often occur, it has nevertheless taken place about four or five times in each year.

The mean number of days on which *rain* fell for the same period is 73 per year, and the number of days on which *snow* fell is 43, making a sum of 116 days on which precipitation took place, leaving 249 fair days as a yearly mean for the 7 years,—there is on an average of about 110 nights suitable for astronomical purposes in each year.

The yearly mean amount of rain for the same period was 43. 004 inches in depth on the surface, and the depth of snow also on the surface, shows a yearly mean of 95.76 inches. The monthly mean for snow and rain are as follows :—

	Inches of Rain.	Inches of Snow.		Inches of Rain.	Inches of Snow.
January,............	0·600	22·38	July,............	3·003	......
February,...........	0·167	25·00	August,..........	5·908	......
March,..............	0·380	18·79	September,.......	5·831	......
April,..............	4·624	2·46	October,.........	6·063	1·80
May,................	4·386	.....	November,........	5·055	4·34
June,...............	6·013	.....	December,........	0·940	17·71

This gives a mean of 52,380 inches of rain and melted snow, this is reduced by the Smithsonian formula, which does not hold good or correct for low temperatures, and I think 1 to 8 would be more accurate. The greatest amount of rain which fell in 24 hours, on record here, was in September 1853, and amounted to 5,142 inches, but this is unusual ; you will perceive that we are little more than five months without snow.

The difficulty in this climate of measuring the amount of evaporation from the surface of water, except for 7 months of the year, owing to frosty nights, has induced me to undertake the registration of the amount of evaporation from the surface of ice during the remainder of the year, (5 months) so as to compensate in some measure for the defect in the observations on the amount of evaporation from the watery surface. These combined observations give a mean of more than 30 inches as the amount of water evaporated. The evaporator is shaded from the sun and rain, but is exposed to the currents of wind, so is also the icy surface in winter.

I am led to believe this amount is tolerably correct. The mean amount of evaporation from the surface of water alone for the 7 months is nearly 21 inches, the remaining amount being furnished by the evaporation which takes place from the surface of ice during the remaining 5 months.

Winds.—The most prevailing wind of the year is the Westerly, and the mean direction for the 7 years in the different months is as follows :—

January, ...	N.E. by E.	July, ...	S.W. by W.
February, ...	W.S.W	August, ...	W.N.W.
March, ...	W.	September,..........	W.N.W.
April,...............	N.E. by E.	October,.............	W. by W.
May, ...	N.W. by N.	November,...........	W.N.W.
June,................	S.W. by W.	December,..........	N.E. by E.

The greatest velocity on record here exceeds somewhat 60 miles per hour linear,—there seems a disposition for a change both in the direction and velocity, at 3 p.m. and at 3 a.m., which corresponds precisely with the diurnal barometric fluctuations. The whole amount of miles linear of wind during the past year (1856) was 53061,63 miles, which being resolved into the four cardinal points, gave, N. 6969,80 miles ; S. 5298,89 miles ; E. 10776,40 miles, and W. 30016,56 miles. The maximum velocity during the past year was 44,40 miles per hour. There were 2220 hours 15 minutes calm, and 6546 hours during which the atmosphere was in motion. Below is a table of the anemometric observation during the year 1856, showing the direction and amount of miles from each quarter of the compass, and also the amount of miles run in each month, also the amount of calm in hours for each month :—

Course.	Velocity in Miles.	Course.	Velocity in Miles.	Course.	Velocity in Miles.
N.	310,50	S.E. by E.	403,00	W.S.W.	4679,66
N. by E.	211,50	S.E.	297,00	W. by S.	4542,50
N.N.E.	412,00	S.E. by S.	690,20	W.	3111,80
N.E. by W.	661,70	S.S.E.	374,00	W. by N.	3103,00
N.E.	1325,00	S. by E.	578,50	W.N.W.	4790,00
N.E. by E.	8092,60	S.	714,70	N.W. by W.	2112,80
E.N.E.	892,70	S. by W.	238,30	N.W.	2728,00
E. by N.	237,10	S.S.W.	497,57	N.W. by N.	1269,00
E.	86,30	S.W. by S.	608,10	N.N.W.	687,00
E. by S.	156,00	S.W.	2375,70	N. by W.	77,00
E.S.E.	240,00	S.W. by W.	3845,60	....	....

RESOLVED INTO THE FOUR CARDINAL POINTS.

Months.	Miles North.	Miles South.	Miles West.	Miles East.	Total Miles.	Hours and Min. calm
Jany.	395·40	95·77	4115·66	1744·10	6351·23	143·00
Feby.	71·90	280·00	4854·80	277·20	5463·90	166·00
March.	674·80	917·30	3706·60	567·70	5866·40	177·00
April.	234·00	116·00	1644·00	2585·10	4579·10	247·00
May.	1415·00	484·00	1323·00	1321·00	4540·00	179·10
June.	350·00	768·00	1450·00	582·00	3130·00	168·40
July.	776·00	345·00	1652·20	111·00	2884·00	174·20
August.	621·00	242·30	1018·20	569·30	2450·00	269·20
Sept.	471·00	589·50	1249·00	490·00	2799·50	243·14
Oct.	843·00	371·00	2270·00	248·00	3752·10	226·45
Nov.	653·00	650·00	2386·00	975·00	4644·00	149·00
Dec.	464·70	458·00	4387·00	1310·00	6628·20	78·30

The yearly mean intensity of the sun's rays for the same septennial period, is 102° 6, and for the months as follows :—

January,	79° 4	July,	121° 4
February,	87° 5	August,	118° 4
March,	119° 4	September,	103° 9
April,	107° 1	October,	99° 4
May,	110° 5	November,	89° 7
June,	110° 2	December,	84° 9

The yearly (septennial) mean of Terrestrial Radiation was 11° 6, and for the months as follows :—

January,	20° 9	July,	46° 7
February,	22° 6	August,	38° 1
March,	18° 2	September,	34° 2
April,	8° 0	October,	18° 9
May,	29° 6	November,	11° 6
June,	39° 1	December,	25° 1

The amount of dew is very variable, but bears a proportion to the degree of terrestrial radiation.

The mean of cloudless days were 57 days perfectly cloudless—the prevailing clouds are the Cumuli Stratus and Cirri Stratus.

The song Sparrow—(*Fringilla Melodia*)—The harbinger of the Canadian spring generally makes its first appearance the first week of April. Frogs, *Rana*, are first heard about the 23rd of April. Shad, *Alosa*, are caught the last week in May. Fire-flies, *Lampyrus corusca*, are first seen about the 24th of June, and the Snow-bird, *Plectrophanes nivalis*, generally makes its first appearance about the 20th of November; Swallows, *Hirudo rufa*, about the 18th of April. Our winter generally sets in about the latter week of November or the first week in December, and is ushered in by a fall of snow from the N.E. by E., and this is the

point from which our winter storms come. Rain generally comes accompanied with a wind from the S. S.W. or S.E., and also from the N.E. by E.

We have generally a few days of that poetic season, the Indian Summer in November.

> " The years last lovliest smile,'
> That comes to fill with hope the human heart;
> And strengthen it to bear the storms awhile,
> Till winter's days depart."

Our snow storms of winter are from the N.E. by E., and for some hours before they form, the Eastern horizon becomes gradually covered with heavy *strata* clouds of a deep leaden hue, the upper strata of clouds are generally a mixture of *Cirri Cumulus* and *Stratus*, moving from the South, but the surface wind is from the point I have stated N.E. by E., the wind during these storms often attain a velocity of some 30 or 40 miles per hour, the barometer is falling and the thermometer somewhere about zero, the Psychometer indicates an increasing amount of moisture, the Electrometers indicate a very high tension of *Negative* Electricity, often an amount of 300 deg. in terms of Volta's No 1. Electrometer, and sparks are constantly passing between the receiver and discharger for hours.

Minute but perfect crystalline forms of snow commence to fall, and may continue for some 48 hours, and I have seen some 12 or more inches of snow fall during this time. Precipitation then ceases; the wind veers *always* by the N. to the W., or W. N.W., with a velocity of some 30 miles per hour, (this is our cold term); and the wind carries the loose finely crystallized snow in clouds before it, this is in Canadian parlance a "Poudrerie." The wind is intensely cold; the thermometer during this period attains a minimum of some 30° below zero. The sky is partly covered by *cumuli* clouds, with a few *strati*—the electrometers still indicate a high tension, but of an opposite or *Positive* character, this Westerly wind may last some 48 hours or more, and lulls down at sunset; may be of the second day into a calm. The blue tint of the sky is very deep, and the rays of the setting sun throws a red or orange shade on the snowy scene, and the atmosphere attains a greater dryness, the electrical action gradually ceases with the wind.

Our thunder storms of summer, which give a yearly mean of 14

(for the same period of 7 years) are of short duration, forming generally in the W. or N.W., and the electricity varies in kind.

The months of April, May and June bring returning summer; the nights of July and part of August are generally oppressive, the temperature often remains at 70° during the night: but the Canadian autumn is very pleasant. The woods with its leaves of a thousand varied tints, and the blue and cloudless sky, with frosty nights, reminds us that the good times of the merry sleigh bells are near.

Notwithstanding these vicissitudes and extremes of temperature, the soil is very productive and vegetation prolific and rapid; and it has again pleased an all-wise Providence, during the present year, to crown the labours of the Canadian husbandman with a bountiful and abundant harvest.

ART. XXX.—*Introductory Lecture to the Course on Botany*, delivered before the Students of Arts and Medicine, McGill College, Session, 1857. By JAMES BARNSTON, M. D., Edin. Professor of Botany, University of McGill College, Montreal.

GENTLEMEN,—The course of Lectures on Botany upon which we are about to enter, is authorised to be delivered in connexion with the Lectures on general Natural History, under the auspices of the Principal of this University. Being called upon to perform the responsible office of instructing you in this department of Science, there are considerations that prompt me to offer one or two suggestions for approval, which will serve to ameliorate the austerity of the circumstances under which we meet. You can readily conceive the difficulties under which a teacher usually labours, who is brought for the first time in presence of a class of intelligent Students—the unpleasant tax upon his nervous modesty, the severe trial of his mental and physical energies accompanied by an inward consciousness of his possible inability to perform satisfactorily the duties before him.

The consciousness of such difficulties generally implants a desire in the teacher to meet faithfully the requirements of his office, employing both time and labour in their fulfilment. The sincere and candid acknowledgment of them may, therefore, be received as a direct apology for such inefficiencies as may become appa-

rent. Under such circumstances, it is becoming in the hearer to overlook the infirmity and extend the indulgence required. It is not for me to demand of you more than necessity requires. That necessity, however, is great, and will compel me throughout the course to draw largely upon your indulgence and patient attention, which I now crave at your hands.

Relying then upon your generous forbearance, it will be my endeavour to fulfil, to the best of my ability, the purposes for which these lectures are intended, namely, to bring prominently before you the beauties and perfection of nature, as exhibited in that portion of God's creation—the vegetable kingdom—to sketch out to you the philosophy of the plant in its structural and physiological aspects, to systematise the varied productions of the earth's surface upon principles derived from an actual study of nature's laws and manifestations, and to adapt the knowledge which botanical science imparts to the true interests of man. In pursuance of these objects, it will be my duty to enter into the minute details of plants, in reference to their structures, functions, chemical composition and natural relations, and show you the value of such scientific knowledge in its application to medicine, horticulture and agriculture.

In a youthful and growing country like this, there is usually a tendency to undervalue a science which apparently cannot promise results of a practical and useful character. The advantages to be derived from a cultivation of scientific knowledge are scarcely recognised in comparison to the supposed greater benefits of an early acquaintance with the grand material object of man's temporal existence. We are all aware that it has been through no ordinary difficulties that we have attained the position we now hold; first, as a community desirous of supporting literary and scientific institutions, and secondly, as a University, whose great aim is the thorough education of the student in matters which will best serve his interests, as an accomplished and useful member of Society. If such have been the difficulties of the past, how much greater now should be the vigour—how much stronger the animus—prompting us to maintain the value and importance of the University in which we labour, as students and professors, to study with spirit and assiduity while within its sacred walls, in order to attain that knowledge which will refine the mind, enrich the intelligence, and entitle us to honor and preferment.

It is difficult at first to estimate the value of a science like Zoology, Geology or Botany and how far the study of the one or the other may bear upon intellectual improvement or general success in life. It is this primary difficulty that forms the great drawback to the more general acquisition of scientific knowledge. It is moreover too often considered that the study of science is an arduous task—one that burdens the head with hard and inexplicable names as well as many useless and may be questionable theories and dogmas. It is much to be regretted that an error of this kind should prevail so universally, since it places science in a false position and prevents the student from attempting what he believes to be a laborious undertaking, and one of little utility, even were he to prosecute his studies and researches successfully. There is but one method of relieving the doubts and difficulties that here harass the youthful mind—it is, to search and receive the testimony of those who have been in their day active and diligent students of nature, acute observers of its laws and manifestations and faithful interpreters of its great truths. The history of such men furnishes ample evidence that there is in science an influence for good, a power within it to improve the quality of the mind and in some measure to regulate human action. In its study there are brought into play, in an eminent degree, such powers and qualities as those of observation, comparison and judgment, which may be at first feeble, but they are gradually increased in vigour and acuteness and at length perfected under the beneficial influence of a well regulated and methodical training. The development of such qualities gives precision and force to the thoughts and actions, and their application to the ordinary pursuits of life renders one more capable of meeting its necessities and overcoming its difficulties. When we observe the advantages of a well-regulated mind, we cannot ignore the importance of those studies, whose tendency is to perfect the qualifications necessary for the successful prosecution of an active business or profession. The most marked facilities are now given in this University for the attainment of scientific knowledge, because it is felt that such a course will raise the standard of general education, open up a new field for the active operations of the youthful mind and give to those of the community, who value their own mental improvement, such instructive information as will tend to elevate their tastes, refine their qualities of mind, and extend the range of their sympathies beyond the contracted limits of a business life. It is within the reach of all, to partake of these advantages and

derive benefit from those efforts which have successfully terminated in the institution of special courses of instruction on the most important departments of Natural History.

To the student who is undergoing a regular course of collegiate education, the sciences of Natural History possess interest of considerable value. They form, as it were, a sister-alliance with his strictly professional studies and, as an adjunct to the latter, contribute materially to the health of his mind. We admit, it is of paramount importance that professional students should be thoroughly educated in the science and literature of their respective professions, a perfect knowledge of which is essential to their callings. But while granting this, we would not hesitate to employ means for the occasional diversion of the mind, by turning the thoughts into channels, giving a wider range for the occupation, improvement and gratification of the senses, the feelings and the imagination. It would thus be in our power to counteract the tendency of an education purely professional, a tendency too apparent, but rarely acknowledged ere it be too late to remedy. And what is this tendency? "To limit the range of mental vision," is the expressive language of one who stood pre-eminent in science, the late Professor Forbes, for, said he, "were the sciences so infused to be entirely professional, we should warp and contract the mind, the tonic would be too strong, would not invigorate but corrugate."

These remarks are applicable to students of all professions, but it is particularly to the student of medicine that the Natural History sciences prove of so much practical value. The necessity and importance of admixing them with his professional studies is an opinion now firmly established, and of the advantages there can be no question. To quote the words of the late Sir George Ballangall, "it is indispensable to any man who aspires to the elevated rank of a Physician." But I cannot do better here than give the testimony of the able authority, (Forbes) previously mentioned, who spoke thus;—"We can most beneficially counteract the natural tendency of purely professional studies, through the collateral sciences, which are sufficiently allied to the professional ones to prevent an undue dissipation of the students' thoughts, and at the same time are sufficiently different to give them a wider sphere of action. It is in this point of view, that we should regard the Natural History sciences as branches of medical education. For my own part, after much intercourse

with medical men, who had studied at many seats of professional education, some collegiate, some exclusively professional, I have no hesitation in saying that, as a rule, the former had the intellectual advantage. There are noble and notable exceptions, old and young, but the rule is true in the main. The man who has studied in a seat of learning, a college or university, has a wider range of sympathies, a more philosophical tone of mind and a higher estimate of the objects of intellectual ambition, than his fellow-practitioner, who, from his youth upwards, had concentrated his thoughts upon the contractedly professional subjects of an hospital school. . . . There are not a few, too (medical men) who may some day find themselves isolated in distant and little-explored regions. Far away from friends and the conversation of intellectual companions, any pursuit that can engage and occupy the mind and above all satisfy its thirst for truth by draughts from the pure and refreshing fountains of nature—any such pursuit becomes a blessing and converts the desert into a paradise, one often filled with creatures yet to be named. How delightful does it then become to be able to recall the lessons of our student-days and casting away regret and languor, invigorate our minds by the practice of healthy intellectual exercise."

In conjunction with such testimony, it will suffice to add that every Medical University, particularly in Britain and on the Continent, that professes to furnish an extended education to its students, not only gives every encouragement and facility for the study of the collateral sciences, as they are called, but the curriculum in each demands imperatively a regular course of instruction in these sciences by qualified teachers or professors, and the subjection of candidates to examination in order to ascertain whether they possess a fair and competent knowledge of them, before receiving their Diplomas. Two courses, one upon Zoology, the other upon Botany, have been prescribed by this University to the student of medicine during his collegiate career, and from the remarks that have been already made in reference to the subject, you will at once discern the laudable motives that have actuated those in authority, in extending your curriculum of study. While it will be to the honor of the University, it is but simple justice to the student and graduate, who will thus find himself prepared, as occasion may require, to meet the demands of other Universities and of every Board of Examination, and ultimately to fulfil his obligations, whether in a civil or military capacity, with credit to himself and the *Alma Mater* from which he hails.

I have thus, gentlemen, laid before you the highest considerations in favor of the prosecution of scientific study, and confessedly with the desire of urging upon you the necessity of weighing them fully, now that you are about to enter upon a course of instruction in that special branch of Natural History, to which I shall have the honor of directing your attention. You will find that the more you are influenced by these considerations, the greater will be your zeal and assiduity, and the more successful will be your efforts to attain a sufficiency of knowledge to gratify the present and enable you to improve the future. Your interest will be excited, as the science of Botany becomes gradually developed, as the grand operations of nature are disclosed and the beautiful phenomena of vegetable life portrayed. The value of the science, in a practical point of view, will be properly estimated as you become acquainted with the economy of plants, their nutritious and medicinal properties, the conditions of soil and climate under which they grow, their capability of special improvement in quality and more especially their adaptation to human interests,—man's life, comfort and happiness.

It is usual, in an introductory lecture, to give a short sketch of the history of the subject that is to engage the attention of the student. I would be unwilling to adopt this course, were it not that the history of Botany furnishes ample evidence of its cultivation, even from an early period, as a practical science, and of the utility of its knowledge in the advancement of the arts, and particularly of Medicine, in the improvement of agricultural operations and the attainment of a more perfect system of gardening. As this evidence of the past will be probably more convincing than any arguments I can here adduce, I propose relating to you a few leading points of botanical history, that seem to me to be of value and importance for the present purpose.

Without entering into any speculations upon the probable amount of knowledge possessed by man, at the earliest period of the world's history, of the nutritious qualities and medicinal properties of plants and the various uses to which they may have been applied, a subject replete with interest, I will date my remarks from a period when we first observe Botany cultivated as a science.

We find the first evidences of botanical study and research among the philosophers of ancient Greece. They devoted themselves principally to the digging of roots and the finding of herbs,

in order to advance the arts and particularly medicine. They were elegantly styled *Rhizomatæ*, (wood-cutters) and not unfrequently nick-named *Pharmacopolæ*, (barterers of medicine or druggists.) They were also called *Cultivators of Physics.* This latter title was somewhat appropriate, for it was not so much the naming and classifying of plants they studied, but their aim was an explanation of their phenomena and their employment as physical substances in arts and trades. The great philosopher Aristotle is reckoned with justice, the first cultivator of the natural science of Plants. He collected and described many medicinal plants, but his genuine works are supposed to have been lost. His favorite disciple, however, the eloquent Theophrastus imbibed the principles and improved upon the information of his great teacher. In his History of Plants, he exhibits deep reasoning and furnishes evidence of his constant and excellent observations of the phenomena of the vegetable world. Theophrastus was also the first who kept a garden for plants, and in his legacy he named some of his scholars as keepers of this property. Immediately after his time, the science of nature lapsed into comparative obscurity till the subjugation of Greece by the Romans, who, acting upon the knowledge imparted to them by the conquered, applied it to rural economy, horticulture and agriculture. It was in the middle of the first century of our era that flourished the most celebrated of writers on ancient Botany. This was Pedacius Dioscorides of Anazarbus in Silicia, a renowned physician who followed the Roman armies in their expeditions throughout the Empire. In his *Materia Medica*, he enumerates all the medicinal plants then known, describes their characters and properties, and gives proofs of their efficacy in diseases. This work held universal sway in the schools for more than 1500 years, as the only fountain of all knowledge relating to Natural History and particularly of botanical information. To him succeeded Caius Plinius Secundus, known as the elder Pliny, who left lasting memorials of his great learning in his "Summary of all Science, Knowledge and Arts." He also added to the list of known plants. A dark cloud again brooded over the science of Botany. Its study was for a long period forgotten or neglected by the Romans. It would seem that during the darkness of the middle ages up to the thirteenth century, the Arabians, who derived their knowledge entirely from Dioscorides through a distorted translation of his work, were the only nation who applied themselves diligently to

the study of medicinal plants; and they were enabled to become acquainted with many remarkable oriental plants through the flourishing trade they carried on for centuries from Madeira to China. It was towards and during the 15th century that a new light dawned over free Italy. Science and Art received an impetus under the spirited influence of rivalry. Dioscorides and Pliny were then taken from the mouldy shelves and studied in the original as pure fountains of botanical knowledge. But it is to the German fathers, schoolmasters and professors of the 16th century, that we look for the first natural exposition of Botany. Among the most learned of these was Gesner, a physician and professor at Zurich, who died in 1564. Besides possessing the merit of being an extensive collector of plants, he described them, gave designs, wood-cuts, and copper-plates, especially of foreign plants, and was the first to draw attention to the important parts of fructification. Lobelius, also, of Flanders, who was afterwards superintendent of the garden of Queen Elizabeth of England, besides his many discoveries, made the first attempt to arrange plants according to a certain natural affinity. Great zeal and diligence were now displayed in the advancement of the arts and sciences, and Botany flourished in every country. It had its advocates in Germany, France, Italy, Portugal and Spain, and the discovery of America enlarged the field of research. Can it be wondered then, that under these circumstances, there was urgent necessity of becoming acquainted with the anatomy and structure of plants in order to their systematic arrangement and classification. These investigations were carried on under the auspices of the Society of London for the promotion of Science, which was liberally supported by Charles II. The discoveries of Grew, Secretary to the society, are recorded in the immortal work, the Anatomy of Plants, published in London in 1682, in which is found the doctrine of the two-fold sex of plants. The same Society published the excellent and peculiar investigations of Malpighi of Bologna. It was the influence of such investigations that gave birth to the classification jo plants according to a natural method. In the beginning of the 18th century, appeared the works of Morison, a Scotchman, and of the celebrated John Ray, an English clergyman, who travelled for many years through all Europe and published his *Methodus Plantarum Emendata*, which gives the principles whereby genera and species should be distinguished, and contains the elements of a natural system, based upon a study of all the parts of the plant.

He was followed by Herman and Boerhaave of Leyden, but there was also laid the foundation of the artificial system—one entirely opposed to the former, and which was soon to eclipse its rival. Rivinius, professor at Leipzic, constituted the corolla, the most important part for the division and classification of plants, and in the promulgation of this doctrine, he was materially assisted by the distinguished French botanist, Joseph Pitton de Tournefort. It was at this time, the beginning of the 18th century, when botanical gardens flourished in Italy, Germany, France and England, (among which may be mentioned the celebrated gardens at Amsterdam in the Netherlands, and at Bologna in Italy, the Royal Garden in Paris, the Royal Garden at Hampton Court, near London,) when native Floras were objects of careful investigation, and when the knowledge of exotic plants of foreign climes was vastly extended by travellers and well-informed naturalists,—it was at this time that Sweden gave birth to one of the most remarkable men in the history of Natural Science, Charles Linnæus, who was born in 1707. To him is Natural History, in all its branches, especially indebted, as the founder of the historical part. He possessed a peculiar relish for Botany, and his writings and works give evidence of his unwearied labours and devotion to the cause of botanical science. He established an artificial nomenclature, gave specific characters to plants, arranged them into genera and formed a gigantic system of artificial classification, in which high value is put upon the stamens and pistil, and upon the corolla. Into the merits of this system we shall hereafter have occasion to enter. Let me merely observe here, that despite the declamations of the promoters of the natural method of classification, who either greatly undervalue or entirely reject the Linnæan system, it stands not merely the historical monument of past genius, but forms a simple key to the naming of plants, and an essential preliminary to the understanding of the intricacies of natural classification. During his own time, Linnæus met with much opposition both in Germany by Haller and the followers of Rivinius, and in France by the disciples of Tournefort, and by Bernhard Jussieu. Other theories and systems were also started and had their supporters. But their influence was merely temporary, and all gave way before the simple and fascinating system of Linnæus.

In process of time, while herbaria were enriched with numerous new plants and systematic works written in Linnæan order, the elementary structure and physiology of plants were more minutely

studied, the organs of reproduction were better examined and due attention was paid to the essential products of vegetation—the fruit and seed. In consequence, the science made rapid advances and resulted in the construction of a natural method and arrangement of plants. France, Germany and Italy vied with each other in discoveries. The botanist of the present day is familiar with the names of Lorentzo Jussieu, Augustus Pyramus Decandolle, Mirbel, Rudolphi and Treviranus, whose works on structural botany and natural systems were published at the beginning of the present century. Since that period, botany has made rapid strides The natural systems of Jussieu and Decandolle have been materially improved by Endlicher, and more especially by Lindley in his elaborate work entitled "The Vegetable Kingdom." The various interesting researches of Gaudichaud, Schleiden, Mohl, Brown, Amici, Griffith, Schultz and others, have in a measure completed our knowledge of the structure and functions of the different parts and organs of plants and of their alliances and affinities; while the labours of Liebig, Mülder and Johnston on the chemistry of plants have tended to the application of botanical science to the interests of agriculture and horticulture, at the same time that others as Christison, Royle, Burnett and Lindley, have supplied valuable data in reference to their medicinal properties and diatetic uses. Not less important and interesting have been the researches and observations, both practical and speculative, made in reference to the geographical distribution of plants over the globe as well as regarding those plants which existed on the earth in its primæval state and which now lie as monuments of vanished forms of vegetable life, buried in the vast geological epochs that elapsed before the establishment of the present order of things.

And what has been the ultimate effect of this? Why, it has raised the standard of botany to the high rank it should hold—rivalling, if not excelling its sister sciences—and has established it within schools and universities as one of the most interesting, beautiful and useful of studies. It claims as its votaries a host of the most accomplished of minds and of the highest order of rank, and it now flourishes in all countries and in every clime. And why should Canada rest satisfied—now that she is interesting herself in the subject of schools and colleges—till she has established these as nurseries of science as well as of arts and literature—nurseries that will rear up youths of talent and ability, to be hereafter claimed as lasting monuments of honor and credit to the country.

You will perceive, from the short sketch just given you, that the tendency of scientific investigations, has been to reduce to practical and useful ends the knowledge acquired by research, and that the spirit of enquiry, however exclusively scientific, has generally subserved in some way one or more of the special interests of man. It will be my anxious desire, in the present course of lectures, to give you a faithful representation of botanical science in its present advanced state, and place prominently before you such important facts and considerations as bear specially on medicine, agriculture and horticulture. I have no doubt you will ere long become interested in the subject and it will give me pleasure to furnish you with such information as you may occasionally require, and such facilities for the prosecution of the study as may be within my power. The deeper your study of the operations and phenomena of nature, the more intimate your acquaintance with the structures and functions of the plant, the greater will be the pleasure and gratification you will experience and the more profouud will be your admiration of this portion of God's creation. With a knowledge of botanical science, you cannot but take delight hereafter in the contemplation of those beautiful and varied objects of nature that will constantly meet your eye, and if you study them as living organizations as well as the manifestations of life they exhibit and the laws which govern them—if you study such phenomena in the true spirit of wisdom, they will subserve a better and higher purpose thán the mere gratification of the mind. They will enrich it with pure and lofty thoughts and raise your souls in admiring contemplation of Him, at whose fiat, at the beginning, "the earth brought forth grass, the herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind," and can we ignore the beauty and perfection of the plant, when it is recorded in the same breath, that "God saw that it was good."

ARTICLE XXXI.—*Description of four species of Canadian Butterflies.*

(*Continued from page* 318.)

GENUS II., PIERIS. *Schrank.*

PONTIA, *Fabricius, &c.*

Palpi, short, cylindrical, moderately compressed, three jointed, the last joint as long or longer than the preceding; antennæ long

and slender, terminated by a somewhat abrupt, compressed, obtuse club, consisting of seven or eight joints, and grooved on one side; wings opaque, and thickly clothed with scales; anterior pair nearly three-cornered, the apical angle not very acute; posterior pair rounded, partly embracing the abdomen, and the discoidal cell closed; legs long, slender, and alike in both sexes, the anterior pair being perfect; tarsi terminated by two equal sized hooklets much curved, each having a small tooth on its under side; between these hooklets is along fleshy cushion, and each is laterally defended by a long conical hirsute appendage; eyes naked; head rather small. Larvæ cylindric,elongated and fleshy, with numerous points or larger tubercles, which emit pale hairs, and are arranged in regular transverse series; the head small and rounded. Pupæ angulated, with a short process in front of the head, and with a projecting lateral appendage behind each of the wing cases, they are attached by a tuft of silk at the tail, and a loose girth round the middle of the body. They do not constantly place themselves in one position with the head upright, but undergo this state in various positions.

This genus is very extensive, the species being distributed over most parts of the globe, but especially in the intertropical parts of the old world, the western hemisphere being comparatively poor in species. The prevaling colour is white, more or less pure, with a black border to the anterior wings, variable in width but seldom wanting. Some of the exotic species are much more varied in their colouring, The underside of the posterior wings generally differs considerably from the upper, and is often very agreeably varied with brilliant colours. The sexual differences in certain species are very conspicuous but in others much less so, the females being distinguished from the males only by a somewhat broader band, or by having the upper wings more rounded at the apex. Such of the larvæ as are known feed almost exclusively on the *Cruciferæ*, especially the species of *Brassicæ*, as well as on the *Residaceæ Tropeoliæ* and *Cappardeæ*. In some years certain of the common English species abound to an astonishing extent, and at such times the cabbages and other cruciferæ in gardens, almost disappear under their attacks. It is nearly the only genus of Diurnal Lepidoptera injurious to man and to keep them in check Providence has provided several small species of hymenopterous parasites, (*microgaster glomeratus*, *&c*,,) which live within the body of the caterpillar till the latter is about to assume the pupa state,

when they issue from its body through a multitude of minute holes and spin their cocoons of yellowish silk in little heaps on each side of the now shrivelled skin of their victim which then falls lifeless to the ground.

Only three species are found in North America. They are *P. oleracea*, *protodice*, and *casta*. The two first of these occur in Canada, and the third which is very closely allied to *oleracea*, but differs in being less strongly marked, and in having no tinge of yellow on the underside, is described by Kirby in his "Northern Zoology" as inhabiting the Hudson's Bay territories. *P. cleomes* of Boisduval is an *aporia*.

Species 1.—Pieris Oleracea, the Grey-veined White.

Pontia oleracea (Harris), Emmons, Agri. N. Y. Ins., p. 204. All the wings above pure white, the base and tips slightly dusky, the nervures blackish brown, and strongly marked; underside also white, slightly tinged with yellowish green, the nervures on the posterior pair edged with dusky scales; antennæ with the club black, tipped with brownish white, the rest brown palest on the underside, and faintly annulated with white; palpi white, thorax and abdomen black, clothed with whitish hairs; legs black; expansion of the wings 2 inches.

Dr. Harris, who first named this species, states that the female lays her yellowish eggs upon the leaves of cabbages, radishes or turnips about the first of June; that they are hatched in about a week, and that the caterpillars attain their full size in three weeks; they measure an inch and a half in length, and are of a pale green colour, and feed indiscriminately upon every part of the leaf. They remain about eleven days in the pupa state.

This species is not mentioned by Boisduval. It appears in May, and continues up to September. It is common in the Northern States, Upper Canada, and the Eastern Townships. It also occurs about Montreal, St. Hilaire, and Quebec, but does not appear to be very numerous at either of these places, and we do not remember to have noticed it at Sorel.

Species 2.—Pieris Protodice.

Plate vi., fig. 3, male; 4, female; 5, female underside.

Pieris Protodice, Boisduval and Leconte, Ico., &c., des Lépidopterès, &c., de l'Amer. Sept. t. 1, p. 45, pl. xvii, fig. 1, 2, 3.

The anterior wings are white with a large, black, trapezoid spot placed in the middle before the margin, and an oblique, spotted

black band, most defined at the anal angle. They have besides, along the margin near the tip, four or five triangular black spots placed upon the nervures. The posterior wings entirely white with sometimes a small group of blackish atoms near the costa. Underside of the anterior wings nearly the same as the upper but the black spots rather paler. The posterior wings slightly tinged with yellow and with a blackish spot upon the edge of the discoidal cell. They are also marked by a marginal mark formed of blackish atoms hardly distinguishable from the ground colour. Antennæ black, tipped with white; abdomen greenish black.

The female is distinguished from the male, which we have just described, by the following characters: the black on the anterior wings above, is more intense, and underneath, they are a little tinged with green at the tips; the posterior wings on the upper side are white a little tinged with greyish, and the hind margin blackish, and marked with five or six white trapezoid spots; their underside has the nervures greenish brown, and a marginal band of the same colour.

Boisduval says this pretty species is rather rare. It appears in the spring, and about the end of June, round New York. It is also found in Connecticut, and we have strong reasons to believe it occurs in the neighbourhood of Montreal. Having now described all the Canadian species of the first family of Diurnal Lépidoptera we reach the second the Heliconiidæ, which, however, is represented in this country by a single species only.

FAMILY 2. HELICONIIDÆ.

This family may be easily distinguished from the preceding, by having the anterior part of legs very small or rudimentary in both sexes, and folded up, not being fitted for walking. They thus appear to have but four legs and are termed *tetrapods* (four-footed.) The joints of the anterior tarsi are very indistinct, and very slightly dentated at the extremity. In some genera, however, the first part of legs, though small, has nearly the same structure as the others. The tarsal ungues or claws of the hind legs are simple, large, and very strong. The antennæ are long, and placed close together at the base, and in general have the club very gradually formed and elongated; in some species they are almost filiform, whilst in a few others the club is rather abruptly clubbed. The palpi are wide apart, slender, cylindrical, rather short, and densely clothed with hair-like scales; the terminal joint gene-

rally very small. The abdomen is elongated. The wings large, in some triangular, in others oblong and narrowed. The caterpillars are cylindric and elongated; they are very variously ornamented, some being glabrous, with several long fleshy prolongations, others are covered with slender spines and tufts of hairs, others again are entirely smooth, and some are clothed with long white hairs. The chrysalides are suspended by the tail, and never supported by a band in the middle. This very numerous family contains some of the most beautiful and remarkable amongst the Diurnal Lepidoptera. Some of the species, especially of the typical genus *Heliconia*, having the wings so scantily covered with minute scales, that these organs are completely transparent. This genus, (*Heliconia*,) is very extensive, but is exclusively confined to the new world, where its metropolis is in the West Indian Islands, and South America. One species is, however, met with in Georgia and Florida, and is common in Mexico.

The Heliconiidæ may be conveniently divided into two subfamilies, viz., *Danaidi* and *Heliconiidi*, the former of which is alone represented in Canada.

SUB-FAMILY,—DANAIDI.

This contains some very large and handsome species. They are mostly inhabitants of the inter-tropical regions, of the old world where they appear to take the place of the *Heliconiidi* of the western hemisphere.

Palpi wide apart, and not rising above the top of the head, their second joint is a little longer than the preceding; club of the antennæ very gradually formed; the wings large, with the discoidal cell of the posterior pair closed; thorax strong and thick; abdomen rather long; anterior pair of legs not fitted for walking, their tarsi hardly distinguishable into five joints, but generally consisting of a single piece with several crowded spines at the extremity. The Larvæ are glabrous, cylindric, rather long, provided with two, four, six, eight or ten fleshy prolongations, which are long, flexible, almost filiform, and placed by pairs on the different segments. The pupæ are shortened, cylindric, without angulosities, and ornamented with brilliant golden spots.

One of the species which inhabits New Holland, it is said, sometimes appears in such vast numbers as to darken the air by the clouds of them.

It is divided into several genera, only one of which inhabits North America.

GENUS 1.—DANAIS, *Boisduval*, EUPLŒA, *Fabricius*.

Head a little smaller than the thorax; antennæ rather long, with a pretty thick, gradually formed, and slightly curved club; palpi widely separated, with the last joint minute, globular and ending in a point, the second long and thick, the radical one about one-third of its length, and all the joints straight, rather broad, and thickly clothed with hairs; abdomen somewhat thin and nearly as long as the posterior wings; wings large, with the margins a little sinuated, the upper pair triangular, the second pair have in the males towards the anal angle, sometimes a blackish pocket or hollow, and sometimes a very black spot divided by a greyish line in relief, placed at the extremity of the nervure; anterior tarsi slightly articulated, but very indistinct, and scarcely any projecting points in the room of the claws.

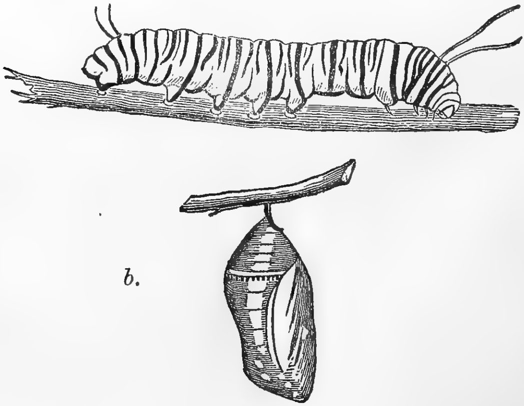
All the species have two marginal rows of spots. Some have the ground colour of the wings rufous with the border black, others are black, with the longitudinal lines and scattered spots of a greenish or bluish white, and sometimes of a greenish yellow. The head, prothorax, thorax and breast spotted with white. The Larvæ generally feed on *nerium*, *asclepias*, *synanchum*, and other plants of the same family. The Pupæ are short, smooth and round, and suspended by the tail.

Two species are found in North America, viz: *D. archippus* and *Berenice;* the first of these alone occurs in Canada. The true country of this genus is the Indian Archipelago, China, Bengal, &c. It also inhabits Africa, and accidentally the south of Europe.

SPECIES 1.—DANAIS ARCHIPPUS. The Storm Fritillary. pl. vi, fig. 1., male, 2, underside.

a.

b.



a, The Caterpillar, b, The Chrysalis.

PLATE VI.

1 Danais Archippus.
2———————(Underside.)

3 Pieris Protodice, (Male.)
4———————(Famale.)
5———————(Underside.)

Danais Archippus, Godart, Enc. Method, ix, p. 184, N. 28, 1821. Boisduval et Leconte, Ico., &c, des Lépridopterès, &c., de l'Amer, Sept., t. 1, p. 137, pl. 40, fig. 1-4, 1833. Gosse, Canadian Naturalist, p. 262, 1840.

Papilio Archippus, Fabricius, Ent. Syst., 111, 1, p. 49, n. 151, 1794. Smith & Abbott, Lepid, of Georgia, vol. 1, tab. vi, 1798.

Papilio plexippus, Cramer, pl. 206, fig. E. F., 1779.

Danaus plexippus, Emmons, Agri. N. Y., Ins. p. 202, pl. 38, 1854.

Papilio megalippe, Hubner, Exot. Saml, 1806.

The four wings are a little sinuated, fulvous above, with a rather brilliant reflection, and the nervures dilated and black. The hind margin is also black, with two rows of white spots, in some individuals a portion of these spots are fulvous. The anterior wings have at the tips a large patch of black upon which are placed three oblong fulvous spots, preceded internally by eight or ten smaller white or yellowish spots, spreading themselves along the middle of the costa, which as well as the inner margin is also black. The underside of the wings is much like the upper, but the spots on the hind margin are larger, and all are white. The ground colour of the posterior wings is a bright nankin yellow, with the nervures very slightly bordered with whitish spots. The notches on the margins of all the wings are bordered with white. Expansion of the wings about 4½ inches. The caterpillar is white, transversely banded with black and yellow. It has two pairs of black fleshy prolongations, the first pair is placed on the second segment, and the other, which is much the longest, on the eleventh. It feeds on various species of *asclepias*, and probably in this country, principally on *A. syriaca* or milk-weed, the "cotonier" of the French Canadians, so well known for its large pods filled with elastic, silky filaments, and from the young shoots being eaten, in early spring, like asparagus. In July its large clusters of purple blossoms are a great resort for moths of various families, and the beautiful chrysomela *Labidomera trimaculata* feeds on its milky leaves.

The Chrysalis is of a delicate green, sprinkled anteriorly with golden dots and marked upon the back a little beyond the middle, with a semi-circle of the same colour, bordered underneath by a row of minute black spots, placed very closely together.

This is a common species throughout the middle States and the West Indies. It is more abundant in Upper than Lower Canada,

but is by no means uncommon in the latter. It appears in July, and there is but one brood during the season. We remember it being named to us, in our early entomological days, as the Storm Fritillary. We have retained this name, although not strictly correct, for it does not belong to the same family as the Fritillaries. It is, however, a very appropriate appellation, as it appears to be most active when the atmosphere is charged with electricity, and often, in those death-like calms which precede a thunderstorm in this country, when not a breath of wind ruffles the glassy surface of the water, and the lurid clouds are hurrying up from the horizon, one of these splendid butterflies may be seen floating past on the sultry air, like a herald of the approaching storm. It generally flies in a slow and heavy manner near the ground, but occasionally soars to a great height in the air. Professor Emmons has repeated an old error in his work on the Insects of New York, by calling this species *plexippus*, and moreover misspells the name of the genus. He also, for some reason not obvious to us, places two species of Nymphalis, (*N. disippus* and *ursula*) with it in the family Helicomiidæ, which he inserts between Papilionidi and Pieridi! *N. disippus* is certainly very similar in colour and markings, but the neuration of the wings is totally different, and the discoidal cell of the posterior wings is open, instead of being closed as in the present species.

FAMILY 3.—NYMPHALIDÆ.

Palpi close together, very erect, densely clothed with hair-like scales, the front of the two first joints almost as broad as their sides, which are also broad; antennæ long, generally furnished with a more or less distinct club which is never hooked; anterior legs entirely rudimentary in both sexes, and quite unfitted for walking; the hind legs with only a single pair of spurs at the extremity of the tibia and the tarsal ungues strongly bifid; posterior wings strongly grooved and their inner margins almost meeting beneath the abdomen, which rests upon them, and their discoidal cell generally open. The caterpillars are cylindric, variable in structure, but generally clothed with numerous strong spines; others have the body smooth, with the head or tail forked. The chrysalides are naked, sometimes armed with small conical protuberances, generally ornamented with metallic colours, and suspended by the tail only.

The species of this family are very numerous and beautiful, and are found in every part of the world, and almost all our commonest butterflies belong to it. They are mostly of the middle size, and few rival the gigantic proportions of some of the Papilionidæ. It is divided into four sub-families, viz: *Argynnidi*, *Vanessidi*, *Nymphalidi* and *Satyridi*, all well represented in Canada. Generally, the sub-families are placed in an inverse order to that which we adopt, but for various reasons we adhere in this respect to the arrangement pursued in Humphreys and Westwood's British Butterflies.

In his work on the Butterflies of North America, M. Boisduval places the *Lycænidæ* between the *Papilionidæ* and the *Heliconiidæ*, on the ground that their pupæ agree with the first family in being supported by a girth round the middle. As, however, there appears to be a natural gradation from the *Papilionidæ* to the *Heliconiidæ* and *Nymphalidæ*, we have followed the arrangement adopted by most English authors.

SUB-FAMILY 1.—ARGYNNIDI.

Palpi long, ascending, closer together at the base than at the tips, second joint the largest, the third small and variable in shape; antennæ long, terminated by a suddenly formed, rounded, compressed, somewhat spoon-shaped club; head broad; anterior legs rudimental in both sexes; discoidal cell of the posterior wings open. The caterpillars very spinose. It is divided into several genera, of which three, viz: *Agraulis*, *Argynnis* and *Melitœa* inhabit North America, but the two last only are met with in Canada. They are termed Fritillaries, (derived from the Latin word *Fritillus*, a chess-board) in allusion to the underside of their posterior wings being generally chequered with silver spots, and various colours, something in the manner of a chess-board.

GENUS 1.—ARGYNNIS.

Head large, as broad as the thorax, which is thick and strong; eyes very large and naked; palpi very hairy, erect, rather wide apart, the terminal joint small, naked and terminating in a point; antennæ rather long, terminated by a very suddenly formed, broad, compressed, spoon-shaped club; abdomen shorter than the posterior wings; wings slightly sinuated; anterior legs rudimental in both sexes, but differing in the following particulars;—in the males they are not only much more hairy than in the females,

but are entirely destitute of articulations, whilst in the females they are much less hairy, and distinctly composed of five joints, even without denuding them of scales, each of the joints having two short spines at the extremity on the inside.

The two genera *Melitæa* and *Argynnis* are so closely allied, it is difficult to give satisfactory characters by which to distinguish them, but the present may be known chiefly by the silver spots which ornament the underside of the wings, being large and conspicuous, and by the tessellated appearance of their upper side.

The larvæ are thickly clothed with spines, two on the first segment next the head being rather longer than the rest. They feed principally on plants of the genus *Viola.* The Pupæ are angular, ornamented with spots of gold or silver and marked with two rows of spots on the back.

The ground colour of the upper surface of the Argynnes is fulvous or reddish brown, marked with a row of sinuated black lines (somewhat resembling written figures) occupying the central cell of the anterior wings, and with several rows of black spots running parallel to the hind margin. It is, however, the beautiful silvery markings on the underside for which they are most remarkable, and which afford the best means of distinguishing the species from each other.

Boisduval describes nine species as being found in North America. We shall describe four as Canadian, of which two are doubtful natives, and of the rest three inhabit Labrador, and the other two the southern States. Very few of the caterpillars of the American species are known, and we are therefore unable to furnish figures of them.

Species 1.—Argynnis Idalia.

Godart, Encyclop. Method ix., p. 263, No. 20.

Papilio Idalia, Fabricius, Ent., Syst. 111, 1, p. 145, No. 446.

Cramer, pl. xliv., D.E.F.G.

Drury, Ins. 1, tab. xiii, fig. 1, 2, 3.

Argynnis Idalia, Boisduval, Ico., p. 147, pl. 43, fig. 1, 2.

Argynnis Idealia, Emmons, Agri, N. Y. Ins., p. 212.

Anterior wings on the upper side fulvous, with fifteen black spots, the five first linear, and situated on the discoidal cell, the next forming a zig-zag tranverse band across the middle of the wing, the rest round, smaller, and disposed in a line parallel to the hind margin; the hind margin is covered by a large black band, dentated internally, divided in the male by a row of fulvous

lunules, and in the female by a row of white spots; the latter has also some white spots opposite the tip, where the black border is considerably dilated. Underneath, these wings are nearly the same as on the upper side, except that the terminal band is less marked and the spots by which it is divided are arrow-shaped, and pearly white. The posterior wings are bluish-black, with the base reddish-brown, traversed, behind the central cell by two rows of large white spots, the outer of which are yellow in the male: underneath this pair of wings is very beautiful; the ground-colour is brown, marked with about 22 pearly white spots, arranged in four rows, parallel to the hind margin; the seven composing the marginal row are somewhat crescent-shaped, and those of the next row, which crosses the disk, wedge-shaped, each surrounded by a black line, the next near the base are of different shapes; the costa, and inner margin are bordered near the base by a streak of pearly-white; the notches of the wings are edged with white; abdomen blackish, the thorax covered with fulvous hairs.

It is found in the neighbourhood of New York and Philadelphia, and may possibly occur in the Eastern Townships and Upper Canada. It also inhabits Jamaica.

ARTICLE XXXII.—*Farther Gleanings from the Meeting of the American Association in Montreal.*

In our notice in last number, we were obliged to omit many topics of interest, partly from want of space and partly from the difficulty of obtaining in time the materials required. We propose in the present article to recur to some of these points.

One of the earliest subjects which engaged the attention of the Local Committee was the invitation of men of science from Europe; and large numbers of circulars, accompanied by all necessary information respecting routes of travel, were scattered over Great Britain and the Continent. Courteous replies were received from many of the institutions and gentlemen addressed, but few were found to be able to accept the invitation. Hopes were at one time entertained that Sir Roderick I. Murchison and Sir Wm. Hooker would have honoured the meeting with their presence. It proved impossible for either to come; but, instead of the former, we had the pleasure of welcoming his able assistant in the geological sur-

vey of Great Britain, Professor Ramsay; and to represent the botanists of England, and the Linnean Society of London, we had Mr. Seaman, one of the more eminent of the younger cultivators of botanical science. Both of these gentlemen made themselves very useful in the meetings of the sections. Prof. Ramsay, in particular, at once took his place as a leading mind in geological science; and by his union of bonhommie and ready utterance, with profound and extensive knowledge, took a firm hold both of the hearts and heads of the members. The mathematical and physical science of Great Britain had but one eminent representative—Prof. Kelland, of Edinburgh, whose presence in the physical section was warmly greeted by the American physicists; though his dislike of public display prevented him from taking a prominent part in the public meetings.

It is to be regretted that the efforts of the Committee were unable to secure the presence of any of the *savans* of France or Germany; but even the partial success which attended the invitations sent to Great Britain is a proper subject of congratulation; and, taken in connection with the number of American men of science who attended the late meeting of the British Association, gives reason to hope for a more cordial union of scientific men on the opposite sides of the Atlantic. A practical union of the American Association with its older and greater sister of Britain is much to be desired. Why may not Canada, as a middle ground, some day secure a joint meeting of both these bodies. As an initiatory foreshadowing of such a communication, we insert a few sentences from the address of the President of the Natural History Society:—

"We believe that Science knows no political limits. The great physical laws of the Universe are the same in all lands. Geological structure and animal and vegetable life are everywhere framed on one uniform type. We cannot attempt to nationalize science without losing its greatest results. But we are connected with our American scientific friends by still closer ties. We are one with them in language, institutions and origin. Descended with them from that great people that, alone of the nations of the world, has the vigor to beget children in its own likeness, and capable of maintaining an independent existence, we acknowledge their great nation as a brother. We regard it not as a prodigal that has left his father's house to waste his father's substance, but as an honorable adventurer who has departed from his paternal

home to establish himself in honest independence; and we delight to welcome him as a visitor to our corner of the old homestead of John Bull. We of British America desire to think of the British people as one in all parts of the world; and not as one only in those Anglo-Saxon and Celtic elements which form its nucleus; but along with all the other peoples and races that have been united with it. Taking this large view of British national existence on both sides of the Atlantic, we cannot be accused of presumption in believing that this great aggregate of nations, spreading itself over the world, and standing with one foot on the land and the other on the sea, points more than any other people to the highest destinies of the human race, and to the final union of all nations, peoples and tongues in the brotherhood of mutual benefits. We love, too, to regard British America as an important connecting link between Britons of the old and the new world. Our country is rapidly rising to a position which may enable it to vie with the United States themselves; and retaining our connection with the maternal state, while we are united by the closest ties with our brethren of the South, we desire to cultivate that mutual good will which is so important to the welfare of the world. In what way can we better do this than through the amenities of science, and by inviting to mingle with us those minds that, more than any other, are building up the fabric of American greatness. Nor is our ambition in this direction limited by this meeting, great and successful though it may be. We hope that there may yet be held in this, the chief city of British America, another meeting of the American Association; and not of it alone, but of the British Association also, that we may thus unite these two great bodies, and gather around them delegates from every other Scientific Society."

The preparations made by the city of Montreal, in a pecuniary point of view, appear, from all that we can learn, to have been quite adequate to the occasion. The accommodation afforded to the sections was ample; and the amount of private hospitality, and the number and character of the public entertainments, were not inferior to those of previous meetings of the Association. The magnificent collection of the Geological Survey was an object of deserved admiration. The collection of the Natural History Society, arranged for the occasion, presented a most creditable appearance, and afforded a very good representation of several departments of the Zoology of Canada. The Botany of the envi-

rons of Montreal, and several points in its natural history, were well represented by the collections exhibited in McGill College. The great public works and interesting scenery of the city and its vicinity excited much interest. Last, though perhaps not least, the neat geological map and guide card given to the members was a happy thought, and highly appreciated. Some of these features of the meeting are thus noticed in Silliman's Journal:—

"The eleventh meeting of the American Association for the Advancement of Science opened at Montreal on Wednesday the 12th of August last. The president elect, Professor J. W. Bailey, having died during the year, the vice president, Professor Caswell of Brown University, was the acting President. The number of members in attendance was as large as at any previous meeting. Mr. Ramsay was received as delegate from the Geological Society of London, and Mr. B. Seeman, from the Linnæan Society of London. The departments of astronomy, physics, meteorology and geology, were well represented by papers, and especially the last, and there were also important communications in ethnology; while in zoology, botany, and chemistry, the communications were exceedingly few. A biographical memoir of Mr. William C. Redfield, the first president of the Association, was read by Professor D. Olmsted; and one of Professor Bailey, by Dr. A. A. Gould of Boston. The retiring President, Prof. James Hall, delivered an address on American Geology."

"Commodious accommodations for the meetings, were afforded the Association, at the Court House, by the government of Canada, and generous attentions by citizens of Montreal. Each member was furnished on arrival with a large folded card, containing, on one side, a plan of the Court House, a list of the officers of the Association, and an enumeration of the places of public interest in and about Montreal; and on the other, a map of the city of Montreal and of the St. Lawrence adjoining with its islands, and also a colored geological map of Canada for a circuit of fifty miles around Montreal, showing the outlines of the formations as laid down by Sir William E. Logan, under whom the geological survey is still in progress. One of the principal objects of attraction in the city was the Geological Museum, containing the collections made in the course of this survey. It was remarkable for the extent and variety of rock specimens, and the great number and beauty of the fossils; no geological survey on this or any other continent has been carried forward with greater energy or skill."

To have succeeded in collecting so large a concourse of scientific men from all parts of the United States and British America, and to have so successfully managed the local affairs of the meeting, is in the highest degree creditable to the Local Committee, and will be productive of great and lasting good. The men of science are not so prominently before the public as the leading politicians; but they have a large and deeply seated influence, both personally and through their connection with literature and institutions of learning. That this influence should be of a cosmopolitan, and not of a sectional character, is of the highest importance, and such a meeting as that which has just closed tends more strongly than any other agency in this direction. Nothing connected with literature or science can be more delightful than to see able and learned men from the South and the North, the East and the West, from Republican and British America, quietly and harmoniously discussing questions all of which bear more or less directly on the well-being, not only of America, but of man. Such a spectacle relieves science from any suspicion of being a trifling pursuit, stimulates the mind of the place in which it occurs, honours that place in the estimation of the world, and diffuses around a feeling of amity and mutual helpfulness, that must mitigate, if it cannot overcome, the jealousies of national and local rivalry.

In our present number will be found abstracts of two of the papers referred to in the former notice—that of Prof. Ramsay on the Geological Survey of Great Britain, and that of Dr. Rae on the Search for Sir J. Franklin.

ARTICLE XXXIII.—*Abstract of Professor Ramsay's Paper on the Geological Survey of Great Rritain.*

It has been thought by some of my friends here present that a description of the mode of conducting the Geological Survey of the United Kingdom of Great Britain and Ireland would be interesting in this country, when so many great and important geological surveys are now in progress in the United States and Canada, and, as I believe, will shortly be the case in Nova Scotia. The geological survey of Great Britain was commenced more than 20 years ago by the offer of Sir Henry de la Beche, who commenced a geological survey of England at his own expense. He commenced this survey, beginning in Cornwall, stretching east through De-

vonshire, this being the great metalliferous district of England. After some time he received a little assistance, namely, two of the civil officers attached to the ordnance survey, giving a portion of their time to tracing geological lines, entirely under the supervision of Sir Henry de la Beche. This was found to be insufficient; and when the geological survey had finished in Devon and Cornwall, it transplanted itself to South Wales, and commenced operations on the great coal fields of South Wales, where he received one or two assistant geologists, expecially those who might be supposed to have some skill in tracing coal beds. Before this time a certain grant had been made for the conduct of the survey, and there Sir Henry first made the acquaintance of Sir William Logan (then Mr. Logan), who was at the time living in Swansea, and had for six years been amusing his leisure in constructing a map of the Glamorganshire coal field, which was entirely surveyed by Sir William, and was constructed upon so admirable a system that ever since it has served as a model for all our work when we chance to be conducting operations in any coal field. Pointing to the one constructed by Sir William, Mr. Ramsay said there are no fewer than 25 or 30 beds of coal on this map, and their actual out crop on the ground is traced and engraved. Sir William Logan having done so much in that field, transferred the whole of his work as a present to the geological survey, and occasionally worked himself as an amateur on the survey for upwards of 12 months afterwards. This survey gradually increased. Sir Henry de la Beche was too wise to ask for a large sum of money at one time; but, as the importance of the survey attracted attention, he gradually asked for and obtained enlarged grants to increase the force till at length he had a large staff of geologists organized. His general rule was to seek out young men, not those who had always distinguished themselves in the science, but who were full of energy and love of the subject, and in whom he saw a strong appreciation of the science, He took them into the field with himself and having trained them in the field under his own care, appointed them an area, and sent them out to make operations by themselves, These operations he examined and corrected if necessary, and gave the young men any further assistance they required, until they became all as experienced as himself in tracing lines, faults, &c., &c., in conducting all field operations connected with geological maps. The grant we now have is £6000 sterling a year. In 1845 the survey was remodelled and divided into two portions. One

for Great Britain and another for Ireland. Captain now Colonel James, was appointed Director for Ireland. I was appointed Director for Great Britain. Each of us had a staff of assistants, while Sir Henry de la Beche was then appointed Director general of the Survey. The Geological Museum attached to the survey originated nearly as follows: The Houses of Parliament having been burned down, a commission was appointed to examine into the best stones for re-constructing parliament building. Sir Henry was one of that commission, and while it was in operation, building stones squared and dressed to a six inch cube, were sent in from all parts of the country. The commission examined not only the stones, but what ancient buildings had been constructed with them in order to test their quality of endurance. In consequence of a previous collection of metalliferous mineral specimens and of this large collection having been sent in, it struck Sir Henry de la Beche that there ought to be some building to preserve them, and he merely asked for a small house belonging to Government to store them in. Then he asked for cases to put them in, that they might not only be preserved, but might be examined. By degrees he increased his demands, and Government perceived the importance of a National Geological museum. He asked for and obtained a special building in which to exhibit all the economic and scientific resources of the country connected with geology, and the large and spacious building in Jermyn Street, known as the Museum of Practical Geology, sprung up, with its varied rooms containing suites of all the fossils, building stones and mineral wealth of the country, and everything connected with Geology. The building itself was entirely constructed of British materials. The front of magnesian limestone, the back of brick, the pilasters of Aberdeen and other granites, of Derbyshire and Irish marbles, and of Cornish and Irish serpentines. People are amazed when they enter this building and see so many rich materials for architectural purposes displayed, all of them afforded by the British Islands. Having secured this building, it occurred to Sir Henry, partly in consequence of representation from the mining districts, that to establish a Mining College in connexion with this would be of the greatest advantage to all connected with mining. He proposed, therefore, that certain chairs should be founded in connection with this institution, and the consequence was that in the large and spacious theatre connected with the building, lectures are given on Geology by myself, on Natural History by Professor Hauxley, on Demons-

trations in Palæontology by Mr. Salter, on Mining and Mineralogy by Professor Smythe, on Chemistry by Prof. Hofman, on Physics by Prof. Stokes, on Mechanics by Prof. Willis, and Metallurgy by Dr. Percy. Plan and machine drawing, &c., are also taught. As a necessary result of these operations we have turned out from this school a number of young men who, in geology whether practical or scientific, are beginning to distinguish themselves. Those who get the best certificate are appointed to the Geological Survey, whenever there is a vacancy, if they wish to follow geology as a profession. This year three new assistants were in this manner sent into the field to be trained for conducting field operations. As Director for Great Britain I have thirteen assistants, three of them are senior Geologists. They have served a number of years to get up to that rank on the Survey, perhaps from eight to sixteen years. I have eight assistant-Geologists, younger men who have come on the staff and are struggling to attain some standing in their profession. There are two others whose chief duty is to collect fossils under my direction or that of any of the officers in the staff, under whose charge I may chance to place them. When a young man comes in I place him on the secondary strata—the tertiary strata being too obscure—and after they have laboured on these comparatively horizontal strata, in which the lines are comparatively easily traced, they are transferred to the palœozic districts. In Ireland the same system with an independent staff is pursued under the direction of Mr. Jukes. These are all the field officers employed on the Survey, but in addition to that we have two palæontologists in Jermyn Street, whose duty is to receive all the fossils, examine them, label them, describe and figure them, and if necessary to go into the field and give advice in regard to critical points in palæontology. The maps we work upon are the Ordnance maps. These maps we apply for, and every surveyor takes one or two copies of the district he is in charge of, and traces the geological lines upon it. In this map (pointing to a small quarter sheet map) there are no fewer than eighty geological lines traced. The mountains in this map, are most of them over 2,000 feet high, some of them more than 3000 feet in height. In this map the geological lines of all the different formations are traced. On the maps heretofore published, no fewer than 125 formations, or modifications of them, are indexed by the colors employed, and each of these formations, &c., is traced foot by foot on the ground with many ramifications. The maps used heretofore in England

are all on a scale of one inch to a mile. The tract having been surveyed, the next duty is to construct horizontal sections for its illustration. All the sections published by the survey are on a true vertical and horizontal scale of six inches to a mile. The whole country is levelled across with the level or the Theodolite, as the case may be. By this means, the true form of the ground is obtained, and it is then easy to delineate the actual thicknesses of the various strata. The angles of some of these hills are so steep that it requires bold men to climb them. In rare cases some of the chainmen have refused to do so. After this is done for one section the same is done for all parts of the country in an elaborate manner. Professor Ramsay here explained the construction of the maps which were hung up. He then stated that having completed these horizontal sections, the next step is to construct vertical sections chiefly of the coal measures, and rarely of the other ground. These are made on the scale of forty feet to an inch, and give the precise thickness of the beds of coal in any coal field, and the nature and thickness of the strata which contain them. Underneath each bed of coal we have always fire clay—as I have no doubt it is the case with you—filled with stigmaria. This, then, is the general mode of procedure. But in the north of England, in Ireland and in Scotland, a new scale of Ordnance survey has been adopted. The whole of Ireland is surveyed upon a scale of six inches to a mile, and Scotland and the north of England are being surveyed upon the same scale. This large scale gives immense facilities for accuracy of delineation, especially in the mining districts. These six inch maps are sometimes contoured, the result of which will be that when we come to construct a geological section across the country, it will be much more easily done and will, therefore, be a great saving of money and labour. In regard to the Geological Survey, I cannot say that we trained and sent out Sir William Logan, for he was a trained Geologist before he ever saw the survey, but others have been sent to other Provinces, who are conducting important Geological surveys. The Director of the Geological surveys of India, Professor Oldham, and all his assistants, have either sprung from our Survey or the School of Mines in Jermyn Street. The Director of the Survey of Australia, the Colony of Victoria, Mr. Selwyn, and Mr. Wylie of the Cape of Good Hope, also Mr. Hall, directing the Geological survey of Trinidad, were sent out from the Survey or the School of Mines. A short time before coming here I was asked, in reference to a sur-

vey of Nova Scotia. I recommended the gentleman to come and consult Sir William Logan, as no man was better acquainted with the necessities of a Colonial Survey than he. I firmly believe that the time will come when the authorities not only of Canada and the United States but of every civilized country, will find it to be of the greatest benefit to have not only topographical maps of every part of the country, with all their features delineated in the most accurate manner, but also upon these to have every Geological feature surveyed to the most minute detail, and published at the expense of Government. Our Government is so completely aware of this, and the people of Great Britain are so confident of its advantages that it would never occur to any one to think of stopping the survey of Great Britain from any motive whatever. You will have an idea of the value set upon our labours by the public when I tell you that 5000 sheets of these expensive maps and sections are annually sold in Great Britain. They are published bythe StationaryOffice, and are sold through Longman & Co. The profit, if there is any, goes to the Stationary Office, but their object is to sell them as cheap as possible, without any reference to money returns. Coloured maps such as these (pointing to those hanging up) are sold from 2s 6d to 8s. according to the amount of work in them; the sectional sheets are 5s each. We are now well aware in Britain that the importance of our country in the scale of nations depends upon its mineral wealth. Government, therefore, freely grants whatever is considered essential to the Survey. We have as many men upon the Survey at present as we can use. But if we found it necessary to double the number and to ask for increased grants, I fully believe it would be freely given. We have published about 50 sheets of maps, embracing an extent of about 36,000 square miles. About 50 horizontal sections of the country illustrate these maps, and about 20 sheets of vertical sections of the coal measures are already given, and we intend to proceed in the same way with the rest of the country, I ought to have mentioned that two years ago Sir Henry de la Beche worn out in body and mind gradually sank and died, regretted by all his friends, men of science, and especially by those to whom he had long endeared himself, who were connected with him in an official capacity. He was succeeded by Sir Roderick Murchison, a gentleman whose previous geological labors and great skill in the field fitted him more thoroughly than any other person to succeed Sir Henry de la Beche, whose monument it is to have estab-

lished this Survey, Museum and School of Mines, a monument which will remain so long as geology is known on the other side of the Atlantic, and I am sure will be equally appreciated here.

ARTICLE XXXIV.—*Abstract of Dr. Rae's Account of the Expedition in Search of Sir J. Franklin.*

Dr. Rae, at the request of the Chairman, then addressed the section. He said that previously to the expedition in which he discovered these relics, he had been engaged in four boat expeditions to the Arctic regions, and had traced some 2000 to 3000 miles of coast. This last expedition of his was undertaken more for the purposes of geographical information than to search for Sir John Franklin—that having been a secondary consideration, as he had hardly expected to find any traces of Franklin's party. But in the course of his travels he fell in with an Esquimaux, who had seen a party of whites the winter before, who were dead. They were in possession of several watches, spoons, &c., with crests upon them, which proved to be those of persons belonging to Franklin's Expedition, including the decoration of Sir John's order of Knighthood. He bought these from the Esquimaux for saws, daggers and other weapons. Doubts have been expressed in several quarters as to the honesty of the Esquimaux, and it was suggested that they might have murdered Franklin's party and robbed their bodies. He had always found them honest and trustworthy, and much more cleanly in their habits than those Dr. Kane met with. He found them extremely accurate in their remembrance and description of what they had seen. He wintered among them in 1847. They described to him the visit of Parry and others twenty years before, with such minuteness, that he recognised their visitor as Parry, who had subsequently confirmed to him (Dr. Rae) the circumstances concerning his visit which they related. All the time he was among them they never stole an article. He went away on a distant expedition, leaving three men behind him with stores. They were never molested in any way, and nothing was taken from them, though the Esquimaux would have made much more by murdering and robbing them, than by the destruction of Franklin's party. In the eastern part of the continent there was no instance of that bloodthirsty disposition towards the whites or other Indians, that they showed

on the western side of the continent. On this latter side they were constantly at war with the neighboring Indian tribes, and as these latter were furnished with fire-arms in exchange for peltries by the white men, the whites were regarded as the allies of their enemies. The Esquimaux, among whom he had resided, were very exemplary in their domestic relations. When you went among them the men brought out their wives and children and introduced them to you, and were proud of any notice you took of them. The women were not, as among many other Indian tribes, made slaves and worked like beasts of burden. They had only charge of the snow house and the affairs of the household. In fact, they were extremely kind to their wives, and children were prized as a great blessing. In return, these children always took great care of their parents when they grew too old to labor and provide for their families. So much was this the case, that if children were left orphans there was always a scramble among their neighbors and friends to adopt them. They are very grateful, too. He had had occasion once to do them a kindness. They ran short of food, and he supplied them from his stores. Afterwards, whenever he wanted seal fat for his men to eat with their other provisions, it was left for them at the doors of their houses, the Esquimaux positively refusing all compensation, because, they said, he had fed them when they were in want. They were frank and friendly in their intercourse. He had never had a quarrel with any of them but one, and that man was esteemed so bad a character among themselves, that they begged him to shoot the fellow, and rid them of him, and afterwards tried to get poison wherewith to destroy him. He had no doubt himself about Franklin's course and his fate. He had been heard to say that, if ice came in his way, he should not shrink from running his ships into it. After wintering at Beechy Island, he had tried to get to Cape Walker, and make thence for Behring's Straits. His provisions had failed in the fifth year, and he had tried to get up Back's River, and perished in the attempt. Capt. McClintock had gone out to endeavour to examine the place where the ships had been abandoned, which they knew pretty well, and to determine, if possible, the position of the Magnetic Pole, to discover if there was any shifting which would account for the variations of the needle. He would endeavor also to make the North-West Passage in his vessel, which Captain McClure had only succeeded in doing by walking a portion of the distance. If any man could do

all this it was Captain McClintock. He was admirably fitted for his task, his vessel well adapted for the voyage, and well provided. He only took thirty men with him, and if his own provisions gave out, there were provisions deposited there by previous expeditions sufficient for 100 men for two years. They desired to recover, also, any books or journals which Franklin's party might have left behind them. When he asked the Esquimaux about them they had said they had had several, but not knowing they were of value they had given them to their children, who had played with them and torn them up. He only succeeded in obtaining two leaves of a religious book which an Esquimaux woman had in her work-bag, and which, with the rest of the relics, save those he had with him, he had deposited by order of the government in Greenwich Hospital. The Esquimaux he found most correct in their geographical notions and descriptions. He had only to point out to them on the chart certain places he knew in common with them, and they would give him most accurately the relative situation of another. Thus he ascertained the place where the party had perished, and when parties from his description subsequently went there, they found the remains of a boat, and near it a piece of wood on which the word "Terror" had been stamped. They found also kettles and other utensils belonging to the expedition. They also found a piece of a snow-shoe frame with the name of Mr. Stanley, one of the surgeons of the expedition, carved upon it. He had traced it back to the maker and the man in London from whom Mr. Stanley had bought it. No remains of the bodies had been found; and this was principally owing to the nature of the site where the party perished. They had been seen ere the ice had decayed, in the spring time, on a low beach, which, at times, was doubtless covered with water. The bodies were left to lie there; the other articles moved to a safer place. The former were washed away and lost, foxes and wolves, perchance, aiding in their destruction. Capt. Penny had told him that whales and walruses, which he had left in similar places, had similarly disappeared. Dr. Rae here showed the relics of which he had retained possession. They consisted of portions of the cases of watches, pocket chronometers, gold chain, an anchor badge worn on the shoulder of a ship's petty officer, and a fork with Sir John Franklin's crest upon it. We also had a very nicely made Esquimaux needle. The thread was made from deer's hide. In fact the reindeer furnished them with food,

clothing, and beds. The Esquimaux were very expert in killing deer. They drove them into the water in the autumn in herds, and sometimes killed 30 or 40 at a time. In winter they drove them into pit-falls ingeniously contrived in the snow. These were so prepared that when the deer got in, their haunches were imprisoned and they could not leap out. His men never could manage it. They managed to kill seals too with their spears, when his men could not manage it with rifles. Instead of going headforemost toward the seal, they wriggled themselves towards them on their sides, presenting a broadside to the seal; and whenever they seemed startled, the Esquimaux would imitate a peculiar noise or cry they made from their throats. When they got near enough they speared and held on to them. Dr. Rae's party never managed to shoot them so entirely dead that they would not tumble into their holes and so be lost. With very large ones, the Esquimaux would, while imitating the flipping of the seal's fin, dig a hole in the ice and fasten their line in that, and so hold them. Had they attempted to hold them by their own strength, they ran the risk of being drawn into the water themselves. The Esquimaux he met were much more cleanly than those Dr. Kane described. In winter he was ashamed of his own men in comparison with them. In order to preserve their furs, they cleaned them of all filth or moisture before entering their huts at night; they stripped themselves of all their clothing, each night, and got in between their fur blankets. They washed themselves with snow from time to time, and so kept their bodies clean. His party had tried washing with water, but found they could never dry themselves, as they had no furs. Their snow huts were very warm and clean. They used stone lamps with moss wicks, such as described by Dr. Kane, but they managed so to arrange them that they gave out no smoke, and the ceilings of their huts were pure white and polished, after being heated, with the breath of the dwellers, and the lamps were brazen again like glass. He was satisfied that Kane, who deserved all the credit he had obtained, or more, for the courageous manner in which, with a constitution so weakened, he had endured so much—had made a great mistake when he had used tents, instead of conforming to the habits of the Esquimaux and building snow-huts. His party had slept comfortably in these huts with a deer-skin beneath them on the snow, and one blanket above them. The weight of this bedding for four of them was but 24 lbs. for each man. It

required some skill to build a snow-hut properly, but it was soon learned. The doctor here exhibited a rough diagram, and described the process. In answer to a question, he said the Esquimaux would attack a white bear, and did not consider him a peculiarly dangerous animal. A musk ox, when wounded, was much more so. He had killed several. The robes were of the finest kind, and the under fur he had had manufactured into shawls as fine as cashmere. These skins were not brought into market, the Esquimaux reserving them for their own use.

ART. XXXV.—*Thoughts on Species;* by JAMES D. DANA.

Read before the American Association at Montreal, August 13th, 1857.*

WHILE direct investigation of individual objects in nature is the true method of ascertaining the laws and limits of species, we have another source of suggestion and authority in the comprehensive principles that pervade the universe. The scource of doubt in this synthetic mode of reaching truth consists in our imperfect appreciation of universal law. But science has already searched deeply enough into the different departments of nature to harmonize many of the thoughts that are coming in from her wide limits; and it is well, as we go on in research, to compare the results of observations with these utterings of her universality.

I propose to present some thoughts on species from the latter point of view, reasoning from central principles to the circumferential, and, if I mistake not, we shall find the light from this direction sufficiently clear to illumine a subject which is yet involved in doubts and difficulties.

The questions before us at this time are—

1. What is a species?
2. Are species permanent?
3. What is the basis of variations in species?

1. *What is a species?*

It is common to define a species as a *group* comprising such individuals as are alike in *fundamental* qualities; and then by way of elucidation, to explain what is meant by fundamental qualities. But the idea of a group is not essential; and moreover it tends to confuse the mind by bringing before it, in the

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* From Silliman's Journal.

outset, the endless diversities in individuals, and suggesting numberless questions that vary in answer for each kingdom, class or subordinate group. It is better to approach the subject from a profounder point of view, search for the true idea of distinction among species, and then proceed onward to a consideration of the systems of variables.

Let us look first to *inorganic* nature. From the study of the inorganic world, we learn that each element is represented by a specific amount or law of force; and we even set down in numbers the precise value of this force as regards one of the deepest of its qualities, chemical attraction. Taking the lightest element as a unit to measure others by, as to their weights in combination, oxygen stands in our books as 8; and it is precisely of this numerical value in its compounds: each molecule is an 8 in its chemical force or law, or some simple multiple of it. In the same way there is a specific number at the basis of other qualities. Whenever then the oxygen amount and kind of force was concentered in a molecule, in the act of creation, the species oxygen commenced to exist. And the making of many such molecules instead of one, was only a repetition in each molecule, of the idea of oxygen.

In combination of the elements, as of oxygen and hydrogen, the resultant molecule is still equivalent to a fixed amount, condition, or law, of chemical force; and this law, which we express in numbers, is at the basis of our notion of the new species. It is not necessarily a different amount of force; for it may be simply a different state of concentration or different rate or law of action. This should be kept in mind in connection with what follows.*

The essential idea of a species, thence deduced is this: a *species* corresponds to *a specific amount or condition of concentered force, defined in the act or law of creation.*

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* When we have in view, oxygen and the elements, we are apt to think of their molecules as distinguished by a different *amount* and *kind* of force. But when we consider the manydifferent compounds that may be made of the same elements (as carbon and hydrogen), in the very *same* proportions, we are led to conceive of these as differing molecularly in a different *law* of the same force or forces. When, again, we see the same element under conditions as diverse as any two compounds, as in cases of allotropism, we are still better satisfied with adopting, for the present, the most general expression—a different law of action or condition of molecular force.

Turn now to the organic world. The individual is involved in the germ-cell from which it proceeds. That cell possesses certain inherent qualities or powers, bearing a definite relation to external nature, so that, when having its appropriate nidus or surrounding conditions, it will grow, and develop out each organ and member to the completed result, and this, both as to all chemical changes, and the evolution of the structure which belongs to it as a subordinate to some kingdom, class, order, genus and species in nature. The germ-cell of an organic being developes a specific result; and like the molecule of oxygen, it must correspond to a measured quota or specific law of force. We cannot apply the measure, as in the inorganic kingdom, for we have learned no method or unit of comparison. But it must nevertheless be true, that a specific predetermined amount, or condition, or law of force, is an equivalent of every germ-cell in the kingdoms of life. I do not mean to say that there is but one kind of force; but that whatever the kind or kinds, it has a numerical value or law, although human arithmetic may never give it expression.

A species among living beings, then, as well as inorganic, is based on *a specefic amount or condition of concentered force defined in the act or law of creation.*

Any one species has its specific value, or law of force; another, its value; and so for all: and we perceive the fundamental notion of the distinction between species when we view them from this potential stand-point. The species, in any particular case, began its existence when the first germ-cell or individual was created; and if several germ-cells of equivalent force were created, or several individuals, each was but a repetition of the other; the species is in the potential nature of the individual, whether one or many individuals exist.

Now in organic beings,—unlike the inorganic,—there is a cycle of progress involving growth and decline. The oxygen molecule may be eternal as far as any thing in its nature goes. But the germ cell is but an incipient state in a cycle of changes, and is not the same for two successive instants; and this cycle is such that it includes in its flow, a reproduction, after an interval, of a precise equivalent of the parent germ-cell. Thus an indefinite perpetuation of the germ-cell is in fact effected; yet it is not mere endless being, but like evolving like in an unlimited round. Hence, when individuals multiply from generation to

generation, it is but a repetition of the primordial type-idea; and the true notion of the species is not in the resulting group but in the idea or potential element which is at the basis of every individual of the group; that is, the specific law of force, alike in all, upon which the power of each as an existence and agent in nature depends. Dr. Morton presented nearly the same idea when he described a species as *a primordial organic form.*

Having reached this idea as the starting point in our notion of a species, we must still, in order to complete and perfect our view, consider what is the true expression of this potentiality. For this purpose, we should have again in mind, that a living cell, unlike an inorganic molecule, has only a historical existence. The species is not the adult resultant of growth, nor the initial germ-cell, nor its condition at any other point; it comprises the whole history of the development. Each species has its own special mode of development as well as ultimate form or result, its serial unfolding, inworking and outflowing; so that the precise nature of the potentiality in each is expressed by the line of historical progress from the germ to the full expansion of its powers, and the realization of the end of its being. We comprehend the type-idea only when we understand the cycle of evolution through all its laws of progress, both as regards the living structure under development within, and its successive relations to the external world.

2. *Permanence of species.*

What now may we infer with regard to the permanence or fixedness of species from a general survey of nature?

Let us turn again to the inorganic world. Do we there find oxygen blending by indefinite shadings with hydrogen or with any other element? Is its combining number, its potential equivalent, a varying number,—usually 8, but at times 8 and a fraction, 9, and so on? Far from this the number is as fixed as the universe. There are no indefinite blendings of elements. There are combinations by multiples or submultiples, but these prove the dominance and fixedness of the combining numbers.

But further than this, even numbers, definite in value and defiant of all destroying powers, are well known to characterize nature from its basement to its top-stone. We find them in combinations by volume as well as weight, that is in all the relations of chemical attraction; in the mathematical forms of crystals and the simple ratios in their modifications,—evidence

of a numerical basis to a cohesive attraction; in the laws of light heat, and sound. Indeed the whole constitution of inorganic nature, and of our minds with reference to nature, as Professor Pierce has well illustrated, involves fixed numbers; and the universe is not only based on mathematics, but on finite determinate numbers in the very natures of all its elemental forces. Thus the temple of nature is made, we may say, of hewn and measured stones, so that, although reaching to the heavens, we may measure and thus use the finite to rise toward the infinite.

This being true for inorganic nature, it is necessarily the law for all nature, for the ideas that pervade the universe are not ideas of contrariety but of unity and universality beneath and through diversity.

The units of the inorganic world, are the weighed elements and their definite compounds or their molecules. The units of the organic are *species* which exhibit themselves in their simplest condition in their germ-cell state. The kingdoms of life in all their magnificent proportions are made from these units. Were these units capable of blending with one another indefinitely, they would no longer be units, and species could not be recognized. The system of life would be a maze of complexities; and whatever its grandeur to a being that could comprehend the infinite, it would be unintelligible chaos to man. The very beauties that might charm the soul would tend to engender hopeless despair in the thoughtful mind, instead of supplying his aspirations with eternal and ever-expanding truth. It would be to man the temple of nature fused over its whole surface and through its structure, without a line the mind could measure or comprehend.

Looking to facts in nature, we see accordingly every where, that the purity of species has been guarded with great precision. It strikes us naturally with wonder, that even in senseless plants, without the emotional repugnance of instinct, and with reproductive organs that are all outside, the free winds being often the means of transmission there should be rigid law sustained against intermixture. The supposed cases of perpetuated fertile hybridity are so exceedingly few as almost to condemn themselves, as no true examples of an abnormity so abhorrent to the system. They violate a principle so essential to the integrity of the plant-kingdom, and so opposed to nature's whole plan, that we rightly demand long and careful study before admitting the exception.

A few words will explain what is meant by perpetuated fertile hybridity. The following are the supposeable grades of results from intermixture between two species :—

1. No issue whatever—the usual case in nature.

2. Mules (naming thus the issue) that are wholly infertile whether among themselves or in case of connection with the pure or original stock.

3. Mules that are wholly infertile among themselves, but may have issue for a generation or two by connection with one of the original stock.

4. Mules that are wholly infertile among themselves, but may have issue through indefinite generations by connection for each with an individual of the original stock.

5. Mules that are fertile among themselves through one or two generations.

6. Mules that are fertile among themselves through an indefinite number of generations,

The cases 1 to 5 are known to be established facts in nature; and each bears its testimony to the grand law of purity and permanence. The examples under the heads 2 to 5 become severally less and less numerous, and art must generally use an unnatural play of forces or arrangements to bring them about.

Again, in the animal kingdom, there is the same aversion in nature to intermixture, and it is emotional as well as physical. The supposed cases of fertile hybridity are fewer than among plants.

Moreover, in both kingdoms, if hybridity be begun, nature commences at once to purify herself as of an ulcer on the system. It is treated like a disease, and the energies of the species combine to throw it off. The short run of hybridity between the horse and the ass, species very closely related, reaching its end *in one single generation*, instead of favoring the idea that perpetuated fertile hybridity is possible, is a speaking protest against a principle that would ruin the system if allowed free scope.

The finiteness of nature in all her proportions, and in the necessity of finiteness and fixedness for the very existence of a kingdom of life, or of human science its impress on finite mind, are hence strong arguments for the belief that hybridity cannot seriously trifle with the true units of nature and at the best can only make temporary variations.

It is fair to make the supposition that in case of a very close proximity of species, there might be a degree of fertile hybridity

allowed; and that a closer and a closer affinity *might* give a longer and a longer range of fertility. But the case just now alluded to seems to cut the hypothesis short; and moreover it is not reasonable to attribute such indefiniteness to nature's outlines, for it is at variance with the spirit of her system.

Were such a case demonstrated by well established facts, it would necessarily be admitted; and I would add, that investigations directed to this point are the most important that modern science can undertake. But until proved by arguments better than those drawn from domesticated animals, we may plead the general principle against the *possibilities* on the other side. If there is a law to be discovered, it is a wide and comprehensive law, for such are all nature's principles. Nature will teach it not in one corner of her system only, but more or less in every part. We have therefore a right to ask for well defined facts, taken from the study of successive generations of the interbreeding of species known to be distinct.

Least of all should we expect that a law, which is so rigid among plants and the lower animals, should have its main exceptions in the highest class of the animal kingdom, and its most extravagant violations in the genus Homo; for if there are more than one species of Man, they have become in the main indefinite by intermixture. The very crown of the kingdom has been despoiled; for a kingdom in nature is perfect only as it retains all its original parts in their full symetry, undefaced and unblurred. Man, by receiving a plastic body, in accordance with a law that species most capable of domestication should necessarily be most pliant, was fitted to take the whole earth as his dominion, and live under every zone. And surely it would have been a very clumsy method of accomplishing the same result, to have made him of many species, all admitting of indefinite or nearly indefinite hibridization, in direct opposition to a grand principle elsewhere recognized in the organic kingdoms. It would have been using a process that produces impotence or nothing among animals for the perpetuation and progress of the human race.

There are other ways of accounting for the limited productiveness of the mulatto, without appealing to a distinction of species. There are causes, independent of mixture, which are making the Indian to melt away before the white man, the Sandwich Islander and all savage people to sink into the ground be-

fore the power and energy of higher intelligence. They disappear like plants beneath those of stronger root and growth, being depressed morally, intellectually and physically, contaminated by new vices, tainted variously by foreign disease, and dwindled in all their hopes and aims and means of progress, through an overshadowing race.

We have therefore reason to believe from man's fertile intermixture, that he is one in species; and that all organic species are divine appointments which cannot be obliterated, unless by annihilating the individuals representing the species.

It may be said, that different species in the inorganic world combine so as to form new units, and why may they not in the organic? It is true they combine, but not by indefinite blendings. There is a definite law of multiples, and this is the central idea in the system of inorganic nature. In organic nature, such a law of multiples, if existing, would be general, as in the inorganic; it would be an essential part of the system and should be easily verified, while, in fact, observation lends it no support, not even enough to have suggested the hypothesis.

In one kingdom, the *inorganic*, there is multiplication of kinds of units by combination, according to the law of multiples, and no reproduction; while in the *organic*, there is reproduction of like from like and no multiplication of kinds by combination. And thus the two departments of living and dead nature widely diverge.

Neither does the possibility of mere mixture among inorganic subtances afford any analogy to sustain the idea of possible hybrid mixture indefinitely perpetuated, among living beings. The mechanical aggregation of units that make up ordinary mixture, is one thing; and the combination that would alter a germ, one of the units in organic species, even to its fundamental nature, is quite another. This last is not aggregation. It is as different from mere mixture as his chemical combination and stands somewhat in the same relation, so that the analogy has no bearing on the question.

3. *Variations of species.*

But there are variations in species, and this is our next topic. The principles already considered teach, as we believe, that each species has its specific value as a unit, which is essentially permanent or indestructible by any natural source of change? and we have, therefore, to admit in the outset, if these principles are true, that variations have their limits, and cannot extend to the obliteration of the fundamental characteristics of a species.

To understand these variations, we may again appeal to general truths.

Variation is a characteristic of all things finite; and is involved in the very conditions of existence. No substance or body can be wholly independent of every or any other body in the universe. The most comprehensive and influential law in nature most fundamental in all change, composition or decomposition, growth, or decay, is the law of mutual sympathy, or tendeney to equilibrium in force through universal action and reaction.

The planets have their orbits modified by other bodies in space through their changing relations to those bodies. A substance, as oxygen or iron, varies in temperature and state of expansion from the presence of a body of different temperature; in chemical tendencies from the presence of a luminous body like the sun; in magnetic or electrical attraction from surrounding magnetic, or electrical influences. There is thus unceasing flow and unceasing change through the universe. All the natural forces are closely related as if a common family or group, and are in constant mutual interplay.

The degree or kind of variation has its specific law for each element; and in this law the specific nature of the element is in a degree expressed. There is to each body or species, the normal or fundamental force in which its very nature consists; and in addition, the relation of this force to other bodies, or kinds, amounts or conditions of force, upon which its variations depend. One great end of inorganic science is to study out the law of variables for each element or species. For this law is as much a part of an idea of the species, as the fundamental potentiality; indeed the one is a measure of the other.

So again, a species in the *organic* kingdoms is subject to variations, and upon the same principle. Its very development depends on the appropriation of material around it, and on attending physical forces or conditions, all of which are variable through the whole of its history. Every chemical or molecular law in the universe is concerned in the growth,—the laws of heat, light, electricity, cohesion, étc.; and the progress of the developing germ, whatever its primal potentiality, is unavoidably subject to variation, from the diversified influences to which it may be exposed. The new germ, moreover, takes peculiarities from the parent, or from the circumstances to which its ancestry had been exposed during one or more preceding generations.

There is then a fixed normal condition or value, and around it librations take place. There is a central or intrinsic law which prevents a species from being drawn off to its destruction by any external agency, while subject to greater or less variations under extrinsic forces.

Liability to variation is hence part of the law of a species; and we cannot be said to comprehend in any case the complete idea of the type until the relations to external forces are also known. The law of variables is as much an expression of the fundamental equalities of the species in organic as in inorganic nature; and it should be the great aim of science to investigate it for every species. It is a source of knowledge which will yet give us a deep insight into the fundamental laws of life. Variations are not to be arranged under the head of *accidents:* for there is nothing accidental in nature; what we so call, are expressions really of profound law, and often betray truth and law which we should otherwise never suspect.

This process of variation, is the external revealing the internal, through their sympathetic relations; it is the law of universal nature reacting on the law of a special nature, and compelling the latter to exhibit its qualities; it is a centre of force manifesting its potentiality, not in its own inner working, but in its outgoings among the equibrating forces around, and thus offering us, through the known and physical, some measure of the vital within the germ. It is therefore one of the richest sources of truth open to our search.

The limits of variation, it may be difficult to define among species that have close relations. But being sure that there are limits—that science, in looking for law and order written out in legible characters, is not in fruitless search, we need not despair of discovering them. The zoologist, gathering shells or mollusks from the coast of eastern America and that of Japan, after careful study, makes out his lists of idential species, with the full assurance that species are definite and stable existences; and he is even surprised with the identity of characters between the individuals of a species gathered from so remote localities. And as he sees zoological geography rising into one of the grandest of the sciences, his faith in species becomes identified with his faith in nature and all physical truth.

If then we may trust this argument from general truths to special,—general *truths* I say, for general principles as far as

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The limits of variation, it may be difficult [illegible] characters, is not [illegible]

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established are truths—we should conceive of a species from the potential point of view, and regard it as—

a. A concentered unit of force, an ineffaceable component of the system of nature; but

b. Subject to greater or less librations according to the universal law of mutual reaction or sympathy among forces.

And, in addition, in the *organic* kingdom,

c. Exhibiting its potentiality not simply or wholly in any existing condition or action, but through a cycle of growth from the primal germ to maturity, when the new germ comes forth as a repetition of the first to go another round in the cycle and perpetuate the original unit; and, therefore, as follows from a necessary perpetuity of the cycle—

d. Exhibiting identity of species among individuals by perpetuated fertile intermixture in all normal conditions, and non-identity by the impossibility of such intermixture, the rare cases of continuation from one or two generations, attesting to the stability of the law, by proving the effort of nature to rid herself of the abnormity, and her success in the effort.

e. The many like individuals that are conspecific do not properly constitute the species, but each is an expression of the species in its potentiality under some one phase of its variables; and to understand a species, we must know its law through all its cycle of growth, and its complete series of librations.

We should therfore conceive of the system of nature as involving, in its idea, a system of units, finite constituents at the basis of all things, each fixed in law; these units in organic nature as adding to their kinds by combinations in definite propositions; and those in organic nature adding to their numbers of representative individuals, but *not* kinds, by self-reproduction; and all adding to their varieties by mutual reaction or sympathy. Thus from the law within and the law without, under the Being above as the Author and sustainer of all law, the world has its diversity, the cosmos its fullness of beauty.

I would remark again that we must consider this mode of reaching truth, by reasoning from the general to the special, as requiring also its complement, direct observation, to give unwavering confidence to the mind; and we should therefore encourage research with a willingness to receive whatever results come from nature. We should give a high place in our estimate to all investigation tending to elucidate the variation or perma-

nence of species, their mutability or immutability; and at the same time, in order that appearances may not deceive us, we should glance towards other departments of nature, remembering that all truth is harmonious, and comprehensive law the end of science.

A word further upon our conceptions of species as realities. In acquiring the first idea of species, we pass, by induction, as in other cases of generalization, from the special details displayed among individuals to a general notion of a unity of type; and this general notion, when written out in words, we may take as an approximate formula of the species. One system of philosophy thence argues that this result of induction is nothing but a notion of the mind, and that species are but an imaginary product of logic; or at least, that since, as they say, (we do not now discuss this point), genera are groupings without definite limits which may be laid off variously by different minds, so species are undefined, and individuals are the only realities—the supposed limits to species being regarded as proof of partial study, or a consequence of a partial development of the kingdoms of nature. Another system infers, on the contrary, that species are realities, and the general or type idea has, in some sense, a real existence. A third admits that species are essentially realities in nature, but claims that the general idea exists only as a result of logical induction.

The discussion in the preceding pages sustains most nearly the last view, that species are realities in the system of nature while manifest to us only in individuals; that is, they are so far real, that the idea for each is definite, even of mathematical strictness, (although not thus precise in our limited view,) it proceeding from the mathematical and infinite basis of nature. They are the units fixed in the plan of creation; and individuals are the material expressions of those ideal units.

At the same time. we learn, that while species are realities in a most important and fundamental sense, no comprehensive type-idea of a species can be represented in any material or immaterial existence. For while a species has its constants, it has also its variables, each variable becoming a constant so far only as its law and limits of variation are fixed; and in the organic kingdoms, moreover, each individual has its historic phases, from the germ through the cycle of growth. The general idea sought out by induction, therefore, is not made up of invariables. Li-

mited to these, it represents no object, class of objects, or law, in nature. The variables are a necessary complement to the invariables; and the complete species-idea is present to the mind, only when the image in view is seen to be ever changing along the lines of variables and development. Whatever indidualized conception is entertained, it is evidently a conception of the species in one of its phases,—that is, under some one specific condition as to size, form, color, constitution, &c., as regards each part in the structure, from among the many variations in all these respects that are possible: mind can picture to itself individuals only and not species, and one phase at a time in the life of an organic individual, not the whole cycle.

We may attempt to reach what is called the typical form of a species, in order to make this the subject of a conception. But even within the closest range of what may be taken as typical characters, there are still variables; and, moreover, we repeat it no one form, typical though we consider it, can be a full expression of the species, as long as variables are such an essential part of its idea as constants. The advantage of fixing upon some one variety as the typical form of a species is this,—that the mind may have an initial term for the laws embraced under the idea of the species, or an assumed centre of radiation for its variant series, so as more easily to comprehend those laws.

Again, abrupt transitions and not indefinite shadings have been shown to be the law of nature. In proceeding from special characters to a general species-idea, nature gives us help through her stepping stones and barriers. In former times, man looked at iron and other metals from the outside only, and searching out their differences of sensible characters, gradually eliminated the general notion of each, by the ordinary logical method of generalization. But science now brings the element to the line and plummet, and reaches a fixed *number* for iron and other elements as to chemical combination, etc. By this means, the studying out of the idea of a species seems almost to have escaped from the domain of logic into that of direct trial by weights and measures. It is no longer the undefined progress of simple reason, with a mere notion at the end, but an appeal to definite measurable values, with stable numbers at bottom, fixed in the very foundations of the universe. So, in the organic kingdoms, where there is, to our limited minds, still greater indefiniteness in most characters, the barrier against hybridity

appears to stand as a physical test of species. We are thus enabled in searching into the nature of a species, to strike from the outside detail to the foundation law.

The type-idea, as it presents itself to the mind, is no more a subject of defined conception than any mathematical expression. Could we put in mathetical terms the precise law, in all its comprehensiveness, which is at the basis of the species iron, as we can for one of its qualities, that of chemical attraction, this mathematical expression would stand as a representative of the species; and we might use it in calculations, precisely as we can use any mathematical term. So also, if we could write out in numbers the potential nature of an organic species, or of its germ, including the laws of its variables, this expression would be like any other term in the hands of a mathematician; the mind would receive the formula as an expression for the species, and might compare it with the formulas of other species. But, after all, we have here a mere mathematical abstraction, a symbol for amount or law of force, which can be turned into conceptions, only by imagining (supposing this possible) the force in the course of its evolution of concrete realities, according to the law of development and laws of variations embraced within it.

Miscellanies.

The following is an extract from a letter lately received from Dr. Gibb, of London, by a friend of his in Montreal, in which reference is made to the chalk cliffs on the south-east coast of England:—

"In the month of August I spent a few weeks at Brighton, and made a pedestrian tour along the south-east coast, walking from Brighton to Hastings, a distance of about 48 miles with the indentations, but shorter by railway. I do not recollect in the whole course of my wanderings—I must except Niagara Falls—experiencing such pleasure, information, and satisfaction, as on this occasion, for an opportunity was afforded me of studying some of the grandest objects of nature, in the truly magnificent chalk cliffs along this coast. The distance from London to Brighton is 50½ miles, directly south from London, and the journey is easily done

within a couple of hours, thus giving an opportunity of studying the lines of section through the different strata, especially of the Wealden and the Chalk. There are four tunnels, two of them pretty long, and each time on passing through them, the rattling rumbling noise has reminded me of the Falls of Niagara, resembling the roar of the falls to some extent, but not so loud, nor yet so awful. The recollection is, however, always pleasing. After being some days at Brighton, thoroughly invigorating both mind and body, I started one morning lightly clad, with a little black bag hanging from an umbrella over my shoulder, for Hastings, on foot. The weather was a little cloudy, but very warm, so much so that I dispensed with a superfluity of vesture, but I never felt in better health in the whole course of my life. I walked along the cliffs to Rottingdean, 4 miles from Brighton, and examined the elephant bed described by Dr. Mantell, and Sir Roderick Murchison, recognising the divisions so well described by the former. This bed, I traced for some distance to the east of Kemptown, being lost in the pure chalk, and re-appearing in the low cliffs at Rottingdean; I had previously gone over the same ground and did not procure any fossils. I saw a very nice lot of good fossils from the chalk in a lapidary's shop at this place, but did not like to encumber myself with any at this period of my journey. On leaving Rottingdean I walked over a series of high chalk hills, or more properly hillocks, as there were hollows between them, frequently stopping to examine the perpendicular faces of the cliffs, which were in many places 200 feet high. Added to the majestic grandeur of these cliffs were the views of many fine farms scattered over the neighbouring downs, and here and there immense flocks of sheep were to be seen browsing the scanty herbage, and after a truly delightful and not fatiguing walk I reached the top of Castle Hill, near the little seaport town of Newhaven, and saw a regular sea-beach of oyster shells, many feet in thickness, forming the summit of the chalk cliffs, which were here 150 feet above the level of the sea. On descending this hill I stopped at the "Hope Inn," where I refreshed the inner man, a little after two o'clock with some biscuit, cheese and ale. Not a particle of meat was to be had for love or money, and the walk of 9 miles had most certainly sharpened my appetite. I crossed the mouth of the harbour in a boat, and landed on a beach of shingle on my way to Seaford. On the banks of a small canal or stream which I skirted for short distance, I found a raised recent clay deposit

recently dug, in which were hundreds of bivalve shells with their mouths open, and in some the remains of the animals dried; these were the *Lutricola compressa*, and I preserved a few. I walked along the beach a part of the way, and then turned inland a slight distance, and reached the pretty little village of Seaford, laying in a sort of hollow behind an elevated beach of loose shingle. This part of the country is so quiet and retired, that a party of ladies were bathing in the sea, past Newhaven, in a state of nudity, and a general scramble ensued with a rush towards their clothes until I passed. I made up my mind to stop at Seaford for the night, and took the opportunity of examining the vertical face of a fine chalk cliff to the eastward, the strata of which dipped to the west, thus permitting me to clamber up in various directions, and to pick out with my hammer and chisel a few choice fossils. To the eastward of Seaford the chalk rises to a considerable height, and forms a majestic line of cliffs which extend to the Cuckmere River, and finally terminate in the magnificent promontory of Beachy Head, nearly 600 feet above the level of the sea. After a good night's rest, and a dinner which was served up capitally at this place, I arose refreshed and not fatigued from my walk of yesterday. It had poured torrents of rain during the night, with a tremendous storm, and the weather was a little cool, the day promising to be most lovely. It was about half-past 8 o'clock when I commenced ascending the cliffs, and reached the top without once halting, my walk was then continued along the summit of the cliffs, through hollow and elevation, until I came to the Cuckmere River, but before reaching this stream I counted very distinctly, in the distance, the summits of seven hills, known as the seven sisters, which presented an even serrated appearance. I crossed the Cuckmere River, very shallow and narrow, and paid the coast guard man who rowed me over in advice about his sore eyes. I staid nearly half an hour examining the base of the chalk cliff to the east of the gap at Cuckmere, and then came the most interesting part of my journey. The first hill, which was pretty high, was quietly mounted, the first of the seven sisters, all of which were very tall and high. I sat down on the summit of the second sister and surveyed the prospect seawards, and after traversing the remainder of the sisters, reached a place called Birling-Gap, to the south of East-Dean. I was undecided whether to go along by the coast round Beachy Head, or along the summit of the cliffs, my mind was made up to adopt the former, and by good luck the son of an

intelligent coast guard man accompanied me. It was after eleven o'clock when we started, I knew what I had to encounter, and most dearly paid for it,—for the fatigue and torture of walking along the shingle was absolutely dreadful, enlivened and relieved only by my anxiety to examine the masses of chalk which had fallen along the base of the cliffs, from among which we picked up a few fossils. We entered several caves, made to serve ship-wrecked mariners, one called the Parson's Hole, was most extensive, with several passages, and must be pretty old, as I saw dates cut in the chalk of 1778, 1794, &c. The cliffs varied in height, but were very high in some places, from 300 to 450, and, finally, near Beachy Head 600 feet; and to stand underneath some of them, on top of immense masses which had fallen, with towering masses above threatening to fall, it naturally made one feel more or less nervous. We were exposed to two dangers along this piece of coast, one of being washed into the sea when passing these fallen masses of chalk,—the other of being crushed to death by some enormous mass of chalk rock. After a weary and really toilsome tramp in the heavy shingle, we at last got to the Cows Gap, just beyond Beachy Head, and ascended this steep hill for 600 feet. Being quite exhausted I had to stop several times for breath and rest, until the top was reached at half-past 2 o'clock; when, lo! I had of all things on earth the greatest luxury it was possible to wish for at this time, a glass of rain water. My mouth was parched from my walk on the loose shingle in the broiling sun, my tongue was dry and clove to the roof of my mouth, I did not dare touch the sea-water, and when my lips tasted pure rain water, it was perfect ecstasy and happiness; I drank two tumblers of it, and was thoroughly refreshed and relieved, so that I was now enabled to descend the hill in a northerly direction with a coast guard man of the name of Blackman to the village of Meads, which I reached at twenty minutes past 3 o'clock, and where I dined on a rasher of bacon and eggs. The longest day of my life, I shall never forget this fatiguing walk along the heavy shingley coast round Beachy Head; the cliffs were so stupendous and their whiteness so dazzling, it made one dizzy to look upwards from their base in the burning sun.

I may here remark that there are few places in England in which the chalk can be studied with greater advantage, as the venerable Dr. Fitton has observed before me, than along the range of cliffs, beginning at Brighton and terminating to the eastward

of the precipices of Beachy Head; all the sub-divisions of the chalk, however, are to be seen between the gap at Cuckmere and a place called Sea-Houses, a short distance beyond Beachy Head. At Beachy Head the upper division of the chalk is to be seen in the form of projecting turret-like masses called "The Charleses," not less than 550 feet above the sea. At the bottom of these cliffs we come upon the dark marley beds, known as the chalk marl, of a bluish grey colour, which were well seen at the end of my walk around Beachy Head. From the top of Beachy Head the view was beautiful and grand, to the right Brighton could be seen as the day was clear, and to the left Folkestone in the distance. The ships and vessels in the offing seemed to be at our feet. A peep over the precipices at this place is rather dangerous, as there is nothing to hold on by; when coming around the coast, I hopped frequently from one mass of chalk to the other, and had my foot slipped I would either have been dashed to pieces or drowned in the sea. Although left till rather late, a bed could not be had in the village of Meads if a hundred pounds had been offered for it, it was my lot therefore to walk on some miles further in the pelting rain and pitch dark, until I came among some Christian people at Eastbourne, where I was accommodated at the Anchor Hotel. Next day I pushed on to Pevensey Castle, 5 miles from Eastbourne, went all through it, sat upon one of the towers musing upon its construction, attributed to the Romans. The towers are six in number, and pretty large, and the outer walls are still in some parts surrounded by an immense fosse. It is an example of a regular old fortress with all its curious appurtenances, of keep, drawbridge, &c., and my curiosity was amply repaid by a visit to it. My course was now pursued uninterruptedly till I arrived at the quiet village of Bexhill, seven miles from Pevensey, with its pretty little Church, built about the year 1100. The desire could not be resisted of passing the night here. A few miles further in the morning completed my journey to Hastings, six miles by road and four by rail. I had a good view of the town from the summit of the east cliff, and afterwards went through the remains of Hastings Castle, situated on the west cliff, the town being principally built in the great valley between these cliffs. I shall not dwell longer upon the many interesting features incident to Hastings and its vicinity, but will merely observe that the Wealden rocks are of some importance here; the rare good fortune attended me of procuring a number of bones, such as a vertebra, a rib

imbedded in the solid rock, bones of the feet, and portions of the great thigh bone of the Iguanodon, one of these gigantic crocodile-lizards of the dry land, so well known through the writings of Dr. Mantell. These bones with others were obtained from the weald clay at low tides on the sea shore, and fell into my possession with a number of other choice fossils. My collection had now so accumulated that I returned to Brighton the same evening by railway. In conclusion, I may state that the collections which accrue during my occasional wanderings are becoming very valuable; they are all destined some day to be placed in the museums of Canada."

G.

Notes on Microscopic Literature.

No part of the field of science has within the last few years awakened more interest, or been more fully studied, than those departments of Natural History which require the aid of the Microscope for their full elucidation.

Soirées, Conversationes, and Lectures public and private, having for their subject-matter the "Microscope and its revelations," have become every-day occurrences; and long articles in the Reviews, Magazines, and Newspapers on the same topic, all go to prove how popular the investigation has become.

The instrument itself, both in its mechanical and optical parts, has engaged the attention of able *savans* on both sides of the Atlantic, and in the hands of such workmen as Powell and Ross in London, Spencer and Grunow in America, and Nachet in France, it would appear to be rapidly approaching its limit of perfection.

The beginners' requirements have had special attention. Learned Societies have offered premiums for the best instruments suitable to the wants of students and saleable at a low price. Prize medals have been liberally awarded to preparers of microscopic objects, who now have the rank of a distinct profession accorded to them; and some even confine themselves to one department of the art—that of preparing injections of animal tissues. And a new feature, supplying a manifest want, has lately been perfected in London, as will appear from the following advertisements which we clip from recent British publications:

"Smith & Beck have now completed and opened *The London Microscopical Subscription Room.* Prospectuses to be had on application at No. 6, Coleman-street, London."

"M. Pillischer's *Microscopical Subscription Room*, 88, New Bond-street, opened May 1st, 1856."

"A room has been fitted up with every care for the comfort and convenience of Subscribers, especially as regards light."

"It contains eight Compound Microscopes of various construction, with their respective powers and apparatus; Dissecting Microscopes and Instruments; as well as all the appliances necessary for the examination and preservation of objects, and a Cabinet of upwards of a Thousand Standard Objects, illustrating most of the branches of Microscopic Research, are maintained in perfect order for general reference, as well as the Periodicals and Books of Reference on Microscopical Subjects,"

"The Terms of Subscription are Half-a-Guinea per annum, payable in advance, and entitling a Subscriber to introduce a friend."

The Room is open daily from 12 to 6 P.M.; and till 8 P.M. on Tuesdays and Thursdays.

We commend the idea to our only progressive public body—the McGill College—in the hope that its Governors may ere long announce that a "Montreal Microscopical Subscription Room" is opened with an efficient supply of instruments.

Here is another idea worthy of consideration:

"A Course of Evening Demonstrations on Microscopes and Aquaria, by Samuel Higeley, F.G.S., F.C.S., &c. More especially arranged for those about to visit the sea-side or country, and desirous of establishing Marine or Fresh-water Aquaria. The Course also includes MICRO-PHOTOGRAPHY, and will commence on Tuesday, July 8th, at 8 P.M. Fee One Guinea. Prospectuses and Tickets may be had at 43, Piccadilly."

We shall have something to say on Aquaria in an early number.

It is quite impossible for us to give notes on, or even titles of, all the works bearing on this subject which have lately appeared. The following are some of the more important:

Quekett's Lectures on Histology. Delivered at the Royal College of Surgeons of England. Vol. I. Elementary Tissues of Plants and Animals, 8vo., 159 Woodcuts, $1 75. Vol. II. Structure of the Skeletons of Plants and Invertebrate Animals, 8vo., 364 Woodcuts, $4. H. Balliere, New York and London.

A Microscopic Examination of the Water Supplied to the Inhabitants of London and the Suburban Districts. By Arthur Hill Hassall, M.B., F.L.S. 8vo., Coloured Plates. 2s. 6d. Lond.

The Microscopic Anatomy of the Human Body. By A. H. Hassall. The United States Edition, edited with additions and notes by Henry Vanarsdale, M.D. In 2 vols., 8vo. Vol. I., pp. 560, text. Vol. II., pp. 168, text and 79 Coloured Plates. New York: Pratt, Woodford & Co.

This is a most valuable and able work, the only complete one in the English language with which we are acquainted. This American edition is as good as the English, and has ten additional plates. Dr. Hassall has also written two works on the Adulteration of Food, and the Methods by which such may be detected, among which methods—as may be supposed—the microscope occupies an important place.

Principles of the Anatomy and Physiology of the Vegetable Cell. By Hugo Von Mohl. Translated (with the author's permission) by Arthur Hinfrey, F.R.S.; with an Illustrative Plate and numerous Woodcuts; pp. 158, 8vo. London: Van Voorst.

This work deserves especial commendation. It should be in the hands of every student of Physiology.

Microscopic Objects, Animal, Vegetable, and Mineral; with Instructions for Preparing and Viewing them. By Andrew Pritchard. 5s.

A History of Infusorial Animalcules, Living and Fossil. Illustrated by magnified representations, by Andrew Pritchard. A new edition enlarged. 1vol., 8vo, pp. 704, with 14 Plates; some coloured.

This volume contains a vast amount of information on the Infusoria, but is disfigured and injured by its slovenly arrangement. We notice that the author has lately (1857) announced a new edition in preparation.

Hannover on the Microscope. Translated from the Danish. With Introduction. By John Goodsir, Professor of Anatomy, University of Edinburgh. Edinburgh: Sutherland & Knox.

Gould's Companion to the Microscope. Sixteenth edition, revised and improved. 8vo., plates. 1s. 6d. By H. Gould, Optician. London: Samuel Highley.

The Microscope, in its Special Application to Animal Anatomy and Physiology. By T. H. Huxley, F.R.S., &c., Lecturer on Natural History at the Department of Practical Science.

The Microscope: its History, Construction, and Applications. Illustrated by 500 Drawings of Objects. By James Hogg, M.R.C.S. pp. 440. London: H. Ingram & Co.

The Microscope: its Applications to Clinical Medicine. By Dr. Lionel Beale, Professor of Physiology and Anatomy in King's College, London. 282 Illustrations, and One Chromo-Lithograph. Price 10s. 6d. London: Samuel Highley.

The Microscope in its Special Application to Vegetable Anatomy and Physiology. By Dr. Hermann Schacht. Edited, with the co-operation of the Author, by Frederick Currey, M.A. Second Edition, considerably enlarged. Numerous Woodcuts. Price 6s. London: Samuel Highley.

This author has also written a useful little book entitled "*How to work with the Microscope.*"

The Microscope and its Revelations. By W. B. Carpenter, M.D., F.R.S. With 345 Engravings on Wood; foolscap 8vo., cloth, 12s. 6d. London: John Churchill.

Without giving the author credit for any originality, we are free to state that this work is perhaps the most useful and cheap compilation, which the tyro in Microscopic observation can procure. We however consider, that in view of previous publications, the large space which he has devoted to the history, mechanical construction and accessories of the microscope uncalled for. The American edition, published by Blanchard & Lea, is, we think, superior to the English.

Practical Treatise on the Use of the Microscope: Including the Methods of Preparing and Examining Animal, Vegetable, and Mineral Structures. By John Quekett. Third edition, with 11 Steel and 306 Wood Engravings. 8vo. Price $5. London and New York: H. Balliere.

This work is usually considered a standard. The third edition is enlarged and improved.

The Micrographic Dictionary; A Guide to the Examination and Investigation of the Structure of Microscopic Objects. By J. W. Griffith, M.D., F.L.S., and Arthur Henfrey, F.R.S., F.L.S., &c. Illustrated by 41 Plates and 816 Engravings on Wood. 1 vol., 8vo., pp. 696; or, in 12 Half-Crown Parts. London: John Van Voorst.

This is without doubt the most elaborate and extensive work on general microscopic investigation which has appeared in our language.

A copious introduction (pages x to LX) treats:

I. Of the use of the microscope and the examination of objects.

II. Of the methods of determining structure from—*a*, the *microscopic analysis* of the surface, including—1. the form; 2. the colour; 3. the structure; and 4, the internal structure: *b*, the *histological analysis*: *c*, the *qualitative chemical composition*: and *d*, *the measurement*. The body of the work is arranged alphabetically and each article has numerous Bibliographical citations in which the student is referred to the best and latest works, treating on the specific subject. The authors have given a larger space to Microscopic Botany than to any of the other departments of the science. The plates are tolerably good, and the wood engravings profuse and excellent. We cordially recommend the work as a valuable vade-mecum to the general naturalist, who has not access to an extensive scientific library.

Drops of Water; their marvellous and beautiful Inhabitants displayed by the Microscope, (6 coloured plates; square 16mo; price 7s 6d.; London: Lovell Reeve,) is the title of an elegant and fascinating little volume by Miss Agnes Catlow, well adapted to young folks. Her plates are copied without acknowledgement by a United States writer, a Rev. Joseph Wythes, M.D., in a book entitled "Curiosities of the Microscope." Any one claiming to be a member of both learned professions ought to know better than to act so dishonorable a part.

The British Desmidieæ. By John Ralfs, M.R.C.S.; the Drawings by Edward Tenner, A.L.S. 1 Vol., 8vo.; Pp. 226; with 35 Colored Plates. London: Lovell Reeve.

A Synopsis of the British Diatomaceæ; with Remarks on their structure, functions and distribution; and instructions for collecting and preserving specimens. By Rev. Wm. Smith, F.L.S.; the Plates by Tuffin West. In two volumes, 8vo. Vol. 1, Pp. 89, with 31 plates, some colored, 1853—21s.; Vol. 2, Pp. 107, with 36 plates, some colored, 1856—30s. London: John Van Voorst.

We cordially recommend these two admirable Monographs to the students of Microscopic Botany in Canada. They enter fully into the Habits, Nature, Structure, Reproduction, Classification, Determination and Uses of the Families of which they respectively treat; and are written, descriptions and all, in the English language.

We purpose, from time to time, keeping our readers informed on any new and valuable works which may hereafter be published, and also of such instruments and accessories as may be helpful to microscopie observation. We invite communications from those of them who are original observers, and will be happy to afford such information, advice, or assistance as may at any time be in our power.

SCIENCE AND THE INDUSTRIAL ARTS.

Manufacture of Iron in Great Britain. Little more than one hundred years ago, the quantity of iron made in the kingdom of Great Britain was about twenty-five thousand tons, and at the beginning of this century one hundred and seventy thousand tons. Fifteen years ago this quantity had increased to one and a half millions of tons, and at present the production reaches, or exceeds two and a half millions of tons.

Propeller Shaft Bearings.—An English engineer has originated a novel plan for the construction of plummer blocks, or bearings for shafts, particularly under circumstances where high velocities are required, such as screw propeller shafts. The plan consists in surrounding the journals of the shaft with brass casings. The inner surface of the bearings is grooved, to receive fillets of wood which project beyond the inner surface, like cogs to a wheel, so as to prevent the shaft coming in contact with the metal. Through the spaces formed between the fillets water is allowed to flow freely between the shafts and the bearings, keeping the whole cool, and acting as a lubricator.—Another modification of the invention is to fix the wooden fillets on the shaft, which then rotate with it in the brass bearings. The wood prepared for the purpose is lignumvitæ, which is fonnd so well to withstand friction in machinery.

Lightning Rods Attracting Lightning.—Sir Snow Harris has made a valuable scientific report to Parliament, in which he refutes the fallacy of the unphilosophical assumption that lightning rods "attract" the lightning, and so act as efficient safeguards. It is proved by an extensive induction of facts, and a large generalization in the application of metallic conductors, that metallic substances have not exclusively in themselves any more attractive influence for the agency of lightning than other kinds of common

matter; but that, on the contrary, by confining and restraining the electrical discharge within a very narrow limit, the application of a small rod or wire of metal to a given portion of a building is in reality highly objectionable.

Rotary Pump.—A new description of rotary pump has been invented. The machine consists of a cylinder, around the axis of which work four vanes, connected with the axis by rings, after the manner of a compass or rule joint, and having their edges completely in contact with the internal surface of the cylinder. Their middle points are connected by links to four pins or bosses, symmetrically situated on the inner surface of a disc, working in an eccentric recess in the top of a cylinder. The dimensions of the parts being properly adjusted, the effect of this arrangement is to cause the space between any of the vanes to be maximum when they are on that side of the cylinder farthest from the centre of the recess, and minimum when they are on the other side.

Effect of Metals on the Hair.—M. Stanislas Martin has published, in the "Bulletin de Therapeutique," the curious case of a worker in metals, who has wrought in copper only five months, and whose hair, which was lately white, is now of so decided a green that the man cannot appear in the street without immediately becoming the object of general curiosity.—He is perfectly well, his hair alone being affected by the copper, notwithstanding the precautions taken by him to protect it from the action of the metal. Chemical analysis shows that his hair contains a notable quantity of acetate of copper, and that it is to this circumstance it owes its beautiful green color, which is most singular and remarkable.

The Discoverer of Gutta Percha.—The discoverer of this inspissated sap of an Indian tree—now so extensively used in the arts and sciences—was Dr. Montgomerie, of the Indian medical service, and this only in the year 1845, although many of the countries producing the article have been in European occupation for above 300 years. The mode in which the discovery was made is worth mentioning. Dr. M. observing certain Malay knives and kris handles, inquired the nature of the material from which they were made, and from the crude native manufacture inferred at once the extensive uses to which the gutta percha might be put in the arts of Europe. He purchased a quantity of the raw material, sending from Singapore part of it to Bengal and part to

Europe, suggesting some of the uses to which he fancied it might be applied. The quantity sent to England secured to him at once, as the discoverer, the gold medal of the Society of Arts, his sole reward, until the President of the India Board, on no other ground whatever than this discovery, liberally bestowed his patronage on Dr. M's son.

The Comet of 1556, *being popular Replies to every day Questions.* By J. Russell Hind. (Parker & Son.)—We remembered reviewing Mr. Hind's first work on this subject, as long ago as when he had only discovered two planets, or in 1848. He then believed in the identity of the comets of 1264 and 1556, and believed that a third appearance might be expected speedily. Nine years have elapsed, which, considering the effect of perturbation, is no improbable margin for a conjecture to require. It is to be remembered that we have not those accurate accounts of the appearance of 1264, hardly even of 1556, which would enable the astronomer to use the theory of gravitation, as was done with Halley's comet both in the last century and the present. In the meanwhile, much attention has been paid by astronomers to the subject in the last nine years, and this oozing out to the wide world, the wide world made up its mind that it was to be burnt alive, and fixed a day. The day turned out rather cool for the season, and the world consented to live on. Mr. Hind discusses all the questions in a popular manner, gives his account of the preceding appearances, and of some new historical information of the methods of calculating, &c. It seems that the most recent materials and calculations make it probable that the comet will re-appear between 1857 and 1861. Then follow discussions about the possibilities and the effects of a *collision* of a comet with the earth! Why is the word used? Has the astronomer any reason to conclude that the thickest part of a comet bears as much comparison to our earth in solidity as a puff of smoke from a cigar bears to a granite rock? Are not all the presumptions, and those no weak ones, the other way? May not plenty of comets have already found their level in the higher strata of our atmosphere, and may they not be there still? To be afraid of a comet while we are living on an earth the interior of which we can only judge of by what we see at the crater of the volcano, is about as absurd as for the passengers to look at the possible collision of a donkey with the train, while they have a furnace which vomits hot cinders at their head. So far as we know, that is: for those who want

fears of the unknown, the comets will do exceedingly well: but earthquakes, the possibility of new volcanoes, &c., should not be entirely neglected; and the theory of epidemics being caused by comet matter falling down from the higher air should be cherished. *Athenaeum.*

Basalt and Tufa.

There is reason to believe that much confusion in geology has resulted from want of careful attention to the distinction of truly molten rocks from consolidated volcanic ashes, which, as in the case of the Palagonites of modern volcanic regions, are often re-consolidated by aqueous infiltration into rocks even harder than those cooled from a state of fusion. An interesting experiment on this subject is quoted in the *Journal* of the Geological Society of London, No. 46. (Expt. by A. Beusch Lunt, and Berne Johr., 1855, p. 597). Basalt (sp. grav. 2.877) was ground in water to fine powder, and allowed to remain for some months in a glass cup. It became a hard stone; in the centre black and waxy, externally less dense and grey. Exposed for some time to air, it exhibited an appearance of carbonate of potash. The specific gravity of the nucleus was 2.1588; that of the external portion 2.423. It is probable that, in this case, hydrated silicates were formed out of the basalt; and it would be interesting to have similar trials made with igneous rocks of known composition, and to compare the results with the actual composition of trappean rocks. D.

Native Copper in Scotland.

The occurrence of native copper in Scotland was noticed in a paper, recently read before the Philosophical Society of Glasgow by J. Bryce, Jr., F. R. S.

"The metal occurs at Barrhead in a state of perfect purity, in the Boylestone quarry, about a quarter of a mile north-west of the railway station. The rock is a coarsely crystalline greenstone, a member of the trap series which forms the Fereneze hill ranges, erupted through, overlying and much altering the lower marine coal series which occurs in that district. Through this rock the metal is irregularly distributed in large thin plates, usually attached firmly to the rock, and also coating its surface in broad films, as if laid on by the electrotype process. It occurs also in large lumps, and in flattened dendritic masses. Its origin was ascribed by Mr. Bryce to the circulation of electric currents

through the mass of rock, while passing to the solid state from that of igneous fusion."

The occurrence of the metal in crystalline greenstone is of much interest, especially if not associated with minerals of aqueous origin; and may possiblybe a case of the actual igneous origin of native copper, though we should be inclined to suspect that the appearances may be deceptive, and that it may have been introduced after the cooling of the mass. Mr. Bryce quotes Prof. Dawson's Acadian Geology as describing a similar mode of occurrence at Cap D'Or, in Nova Scotia; but in these two cases, though the metal occurs in the crevices of burathe trap, the appearances are by no means conclusive as to its igneous origin. D.

Reptiles in Ireland.

In a notice, in the *Athenæum*, of the last volume of the "Natural History of Ireland," by the late William Thompson, we find the following on the popular belief of the absence of reptiles from the Emerald Isle:

"Of course, every one would expect that an Irishman should discourse on the alleged absence of Reptiles from his native isle. This is partly true; for although the sand lizard is "common in suitable localities," and the eft is "abundant in some localities," and the natterjack is found in Kerry, yet there is not the slightest doubt that where other common British reptiles, as the snake, the frog, and the toad, have been found, they have been introduced. The frog is common enough now, but Stuart, in his 'History of Armagh,' says: "The first frog that was ever seen in this country made its appearance in a pasture-field, near Waterford, about the year 1630. The grandmother of one of Mr. Thompson's friends used to tell "that, when a girl at school (1736), she was taken some distance to see a frog which was exhibited as a show." At one time, the Irish Frog was regarded as a distinct species, but Mr. Thompson, after a careful comparison with English specimens, regards them as identical. The toad appears never to have been introduced into Ireland. It is curious that its first cousin, the natterjack, or running toad, should be found in abundance in Kerry. The Irish people have always a ready explanation of these natural phenomena, and just as they ascribe the freedom of their island from reptiles to the prayers of St. Patrick, so they ascribe the presence of natterjacks in Kerry, as of potatoes, to their having escaped from a ship. Mr. Thompson, however, be-

lieves this story, and says, it "is borne out by the fact that it is the only part of Kerry that they are to be met in—a district extending from the sand-hills of Inch and Rosbegh, at the head of the Bay, to Carrignafery, about ten miles in length, of low marshy ground, and about the same number in breadth."

Snakes, vipers, and blind-worms are also absent from Ireland. Many attempts have been made to introduce the ringed snake (*Natrix torquata*), but although there are no evident climatic or terrestrial conditions to prevent their increase, they have from one cause or another speedily perished. The physical conditions of atmosphere and earth-surface that regulate the distribution of species are at present but imperfectly understood; there can, however, be no doubt that such agents have been at work in producing this difference between the fauna of Ireland and England. The flora of Ireland, on the other hand, supplies us with species of plants that flourish there, but have never reached so far north as the most southernmost points of Great Britain. It is one of the sources of value of such books as Mr. Thompson's, that facts like the absence of reptiles from Ireland, are thoroughly investigated, and their true significance ascertained.

D.

The New Metal.—Aluminium begins, it appears, to come into more general use, at least in France. The eagles which surmount the colours of the army, hitherto made of copper, gilt by galvanism, are now made in aluminium, thus lightening the weight of the flag by nearly $2\frac{3}{4}$ lbs. Aluminium is more sonorous than bronze, and is consequently brought into use for musical instruments. Spoons and forks, drinking cups, &c., have also been formed of it. The weight of the new metal is about one-fourth that of silver. Fine silver being worth 225f. the kilogramme, and aluminium 300f, a piece of the latter, equal in size to a kilogramme of silver, will only be worth 75f., instead of 225f. Thus, an article which in silver would cost 30f., would be only 16f. in aluminium.

The Sun forever in the Meridian.—Professor Sontag, Astronomer to the "Grinnell Expedition," in his narrative, says—"As the land adjacent to the Pole is all *terra incognita*, it is impossible to say what additions to the stores of natural science a visitor to those regions might be able to make. Certain it is however, that a new and wide field would be opened for his investigation

Everything there would be novel ; and that circumstance alone would be well calculated to stimulate his attentive faculties. The difficulties which would present themselves to the investigator may be appreciated at home ; but they would be greater or less, according to circumstances of which we know nothing. We know not, for example, whether the Pole is covered with open water, or icy sea, or dry land ; nor do we know which of these three conditions would be most favorable for investigation. It may be presumed, however, that an open sea would be, in several respects the most disadvantageous. In the first place, it would in all probability be so deep that the ship would be unable to anchor ; and the current might be too strong to permit her to keep stationary long enough to make accurate observations. In the second place, if she could not maintain her position steadily at one point, the commander would experience a new embarrassment, as the meridian must extend southwardly, he would be apt to lose that on which he approached the Pole—and consequently he would be at a loss how to shape his course homeward.

The occurrence of this strange difficulty will naturally present itself as one among many novel phenomena which will arrest the adventurer's attention, and the following observations would probably occur to him on the spot. The time of day (to use that phraseology for want of any other that would be more appropriate) would no longer be marked by any apparent change in the altitude of the sun above the horizon ; because to a spectator at the pole no such change would appear, except to the small amount of the daily change of declination. Thus, not only to the eye, but also for the practical purpose of obtaining the time by astronomical observations, the sun would appear throughout the twenty-four hours neither to rise nor fall, but to describe a circle round the heavens paralled with the horizon. Therefore, the usual mode of ascertaining the time would utterly fail ; and indeed, however startling may be the assertion, it is nevertheless true, that time, or the natural distinction of time, would be no more. This will appear from the consideration that the idea of apparent time refers only to the particular meridian on which an observer happens to be placed ; and is marked or determined only by the distance of the sun, or some other heavenly body, from that meridian. Now, as an observer at the pole is on no one meridian, but is stationed at a point where all meridians meet, it is evident that " apparent time " for him has no existence.

[illegible] would be [illegible] to abandon [illegible] difficulties which would present themselves to the [illegible] [illegible] as honey; but they [illegible] be [illegible] [illegible] of which we know nothing [illegible] example, whether the rock is covered with [illegible] nor do we know which [illegible] would be most [illegible] for investigation. [illegible] [illegible] the first place, it would [illegible] [illegible] be able to [illegible]

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UNIVERSITY OF McGILL COLLEGE.

We are happy to learn that in the present session, the University of McGill College is beginning to realise in enlarged public patronage the results of its active and enlightened efforts in behalf of improved education. The model schools attached to the McGill Normal School, were filled with pupils on the day of opening, and a large number were unable to obtain admission, the ac comm odation afforded by the school being limited to 230 pupils. In the Normal School, there are sixty-two teachers in training, and we are informed that they are of a high grade in education and ability, and that most of them promise to be excellent teachers. The High School Department numbers 242 pupils, a large increase over the last session, and is giving even greater satisfaction to parents than in former years. The Faculty of Arts has raised its number of regular students to 30. In the Medical and Law Faculties, which opened last week, the classes are scarcely fully organised, but will probably reach to 100 students in both. In all about 650 pupils and students of various grades, will, during the present session, be receiving instruction from this institution, in addition to occasional students who may attend particular courses or popular lectures.

The class in Civil Engineering commenced last week. It gives in two sessions a thorough preparation for active work in that profession; and under an act passed in last session of the Legislature, students who have received the college diploma are exempted from two years of the apprenticeship required of provincial land surveyors. In addition to this advantage they attend lectures in Geology, also required by law as a qualification for land surveyors. No young man intending to enter on the engineering or surveying profession should neglect the educational and other advantages thus offered.

The University is constantly adding to its library, museum and apparatus. An electrical apparatus of the largest size has been procured and will be used in the lectures of this session. The important collection of insects formed by Mr. Couper, of Toronto, has been acquired for the museum, where it will form a worthy companion to those of Dr. Holmes in Mineralogy and Botany, and to the varied collection in other departments of natural history, constantly increasing under the care of the Principal. The collections of Dr. Holmes and Mr. Couper being of some historical

interest in relation to natural science in Canada, it is intended to keep them distinct from other parts of the cabinet, under the names of their respective collectors. It is much to be desired that these treasures in natural science could be more securely lodged than in a building constantly in use for purposes of instruction. We would earnestly recommend to the consideration of any man of wealth desirous of erecting a monument to his own memory, and at the same time of aiding the progress of science, the erection of a fire-proof library and museum in connection with the University. As the University gives every reasonable facility of reference to its collections, such a building might be available for the secure keeping of other literary and scientific valuables beside those which are its property.—*Montreal Witness.*

MEETINGS OF THE NATURAL HISTORY SOCIETY.

It has been resolved that in the meetings of the present winter the business of the Society will be dispatched before 8 P.M., and that immediately after that hour the reading of scientific papers and discussions thereon will be commenced. The first paper of the series will be read by Principal Dawson at the Meeting of Monday November 30. At the following meetings on the last Monday of each month, papers are expected from Mr. Billings, Rev. Mr. Kemp, Professor Barnston, M.D., Sir W. E. Logan, Mr. D. Urbain, Professor Hunt, Professor Hall, M.D., and Mr. Poe. It is probable that several other papers will be read, and the meetings will assume an interesting and scientific character, and will be largely attended. A course of popular lectures is also being organised, and will be commenced in January.

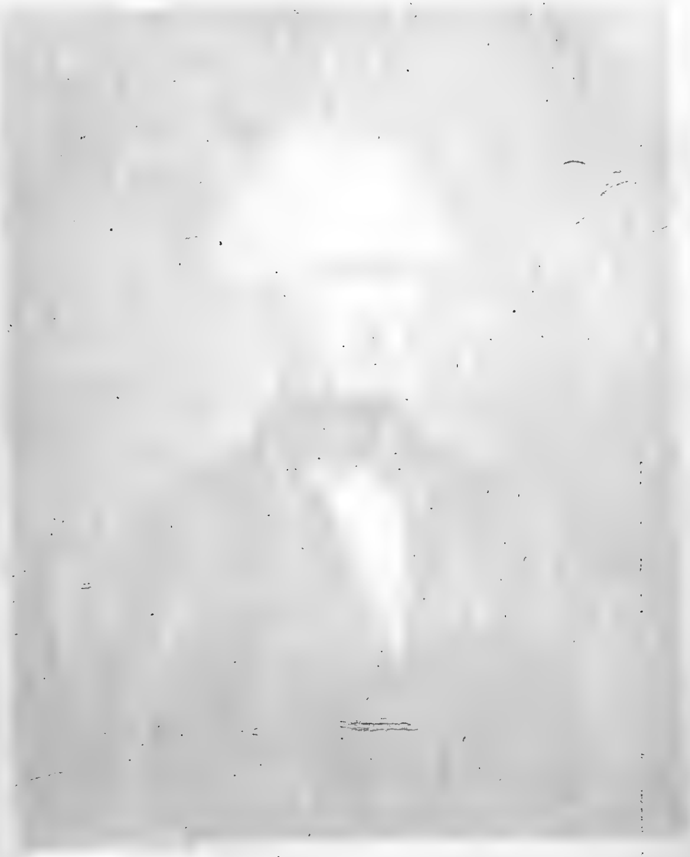
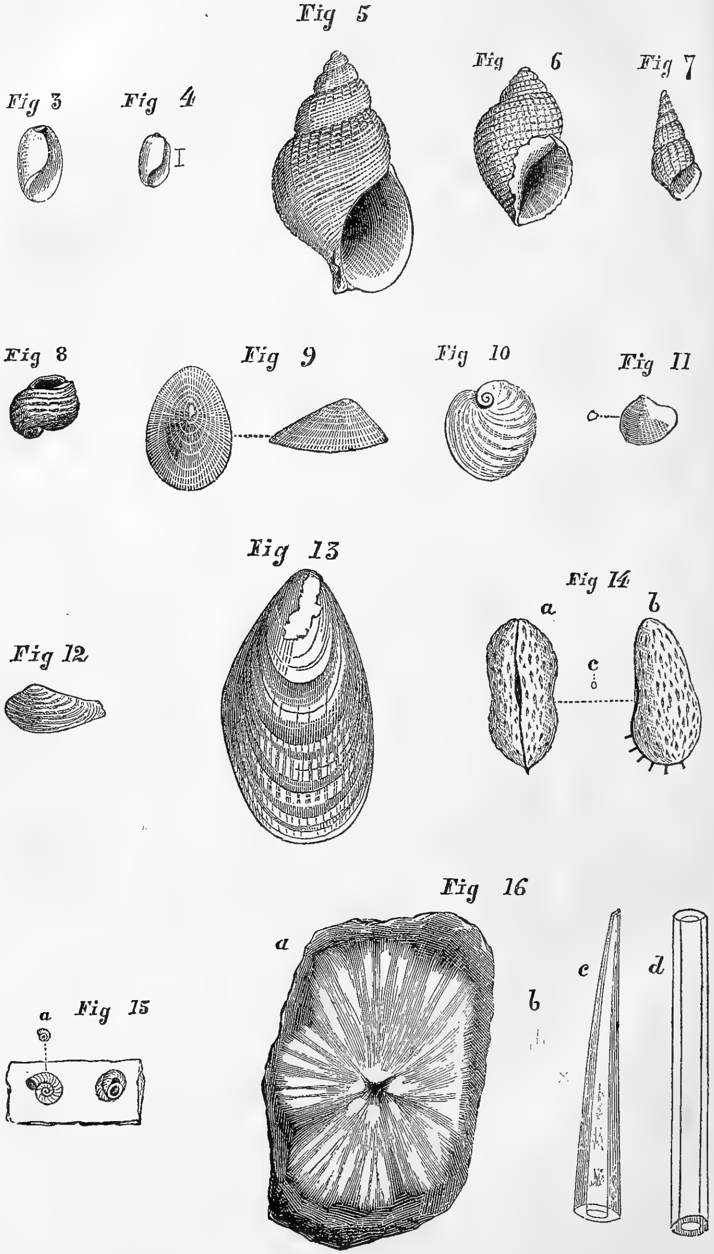


PLATE VII.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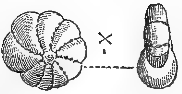

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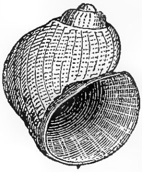

Fig 18

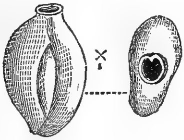

Fig 19

Fig 20

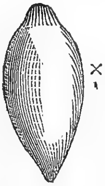

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Fig 22

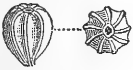

Fig 25

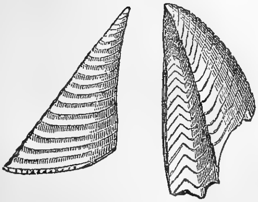

Fig 27

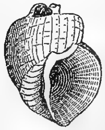

Fig 26

Fig 30

Fig 28

Fig 29

THE

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VOLUME II. DECEMBER, 1857. NUMBER 6.

ARTICLE XXXVI.—*On the Newer Pliocene and Post Pliocene Deposits of the Vicinity of Montreal, with notices of fossils recently discovered in them.* BY J. W. DAWSON, L.L.D., F.G.S., Principal of McGill College.

(Read before the Natural History Society of Montreal, Nov. 30, 1857.)

The deposits to which this paper relates, belong to that wide spread sheet of superficial detritus, by which the greater part of the northern hemisphere was covered at the close of the tertiary and commencement of the recent period. This formation, as it occurs in the lower part of the valley of the St. Lawrence, has been described by Dr. Bigsby, Rear Admiral Bayfield, Sir C. Lyell, Sir W. E. Logan, and Professor Emmons. More recently an excellent summary of the previous publications, with many new facts, was given by Mr. Billings in this Journal; and a paper by the writer on additional fossils recently discovered, was read before the American Association at its late meeting in Montreal.*

* Annals of New York Lyceum, 1st series. Transactions Geological Society, 1839; Proceedings Geological Society, 1851; Lyell's Travels in North America; Reports of Canadian Survey; Emmons' Report on Geology of New York; Canadian Naturalist, vol. 1. The few pages devoted to Montreal in Lyell's Travels, contain a remarkably graphic and accurate view of these deposits as they occur here, and will enable any one not familiar with the subject, much more readily to comprehend the additional details given in this paper.

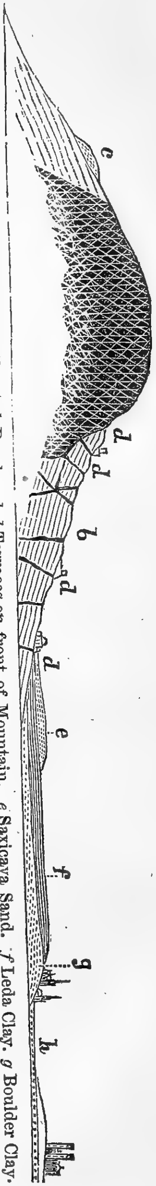
In the present paper I propose to notice the arrangement of the beds in the vicinity of Montreal, and the assemblage of fossils which they contain, in connection with the distribution of the species as inhabitants of the modern seas, and the inferences as to climate and other conditions deducible from them.

The isolated eminence of trap which rises in the mountain of Montreal to a height of about 700 feet, forms up to that elevation, a tide-guage of the Post Pliocene sea, marked on its sides by a series of sea cliffs and elevated beaches, indicating the stages of gradual or intermittent elevation of the land as it rose to its present level. The most strongly marked of these sea margins are at heights of 470, 440, 386 and 220 feet above Lake St. Peter on the St. Lawrence;* or 450, 420, 366, and 200 above the river at Montreal.

The highest of these beaches contains sea shells of existing species. Below the lowest, and at an elevation of about 100 feet above the river, spreads the great tertiary plain of Lower Canada, everywhere containing marine shells, and presenting a series of deposits partly unstratified and partly assorted by water. In this vicinity the regular sequence is as follows:

1. Fine uniformly grained sand, in some places underlaid or re-placed by stratified gravel. Marine shells in the lower part.
2. Unctuous calcareous clay, of gray and occasionally of brown and reddish tints. A few marine shells.
3. Compact boulder clay filled with fragments of various rocks, usually partially rounded and often scratched and polished.

Fig. 1.



SECTIONAL VIEW OF TERRACES AND POST PLIOCENE BEDS—MONTREAL.

a Trap. *b* Limestone with trap dykes. *c* Elevated Beach. *d d* Terraces on front of Mountain. *e* Saxicava Sand. *f* Leda Clay. *g* Boulder Clay. *h* Fluviate Gravel.

* The first of these measurements is given on the authority of the Geological Survey. The others were ascertained for me by Professor Hamilton of McGill College, by levelling. The terraces are not quite level nor their limits always very distinct.

The thickness of these beds is at least 100 feet, of which the lower or boulder clay constitutes the greater part, but the sand often attains the thickness of 10 feet, and the fine clay that of 20 feet.

The boulders are not confined to the boulder clay, properly so-called. The stratified clays and sands often contain large rounded stones, partly of the mountain trap and partly of the older metamorphic rocks of the Laurentian formation, lying to the northward of the St. Lawrence valley. Dr. Bigsby long ago remarked that the boulders derived from the mountain have been drifted principally to the S. W.; in which direction they have been traced as far as the South Shore of Lake Ontario, 270 miles distant from their original position. On the other hand, the successive terraces are best seen on the North East side of the mountain, which is bare and abrupt.

Wherever I have observed the rock surfaces under the boulder clay, they present the striated and polished appearance usual in such positions. On the North East side of Montreal mountain the directions observed were from S. 70° W. to S. 50° W., corresponding to the direction of the drift mentioned above.

In some places the surface of the boulder clay has been deeply cut into furrows by the currents which deposited sand and gravel upon it. In like manner the surface of the stratified clay is sometimes cut into trenches filled by the overlying sand. On the other hand, in places which have been more sheltered, the boulder clay passes into the finer clay or into gravel, and the latter into sand. It is in these last localities, where evidences of denudation are absent, that marine fossils most abound.

The City of Montreal is built on the deposits just described. In the upper part of the city, at the base of the mountain, and at the height of about 100 feet above the river, we see in many places a fine yellowish sand, and about the same level, a little further East, at the mile-end quarries, are stratified gravel and sand. Below this sand we find the fine unctuous clay, forming a thick bed in the upper part of the city, and at the brick yard on the St. Lawrence Road, as well as at the village of the Tanneries. Under this is the thick bed of boulder clay and clay gravel seen in excavations on Dorchester and Lagauchetiere Streets; and at the gravel pits on the Lachine Railway. The steep descent at Beaver Hall Hill, at St. Patrick's Hospital, and along the Lachine road is the true margin of the river bottom, and marks the limit of the cut made by the St. Lawrence in these tertiary deposits.

In this bottom we have in Craig Street, and toward the Tanneries, river gravel, occasionally with fresh-water shells. In some places the river has probably cut through the boulder clay quite to the underlying rock, but in other places this is not the case. In the bottom of one of the most advanced coffer-dams of the Victoria Bridge, I observed a great depth of the original boulder clay, on which the river had made no impression. The mud brought up by the dredging machines from the current immediately below Montreal, and from some parts of Lake St. Peter, is evidently the undisturbed marine clay. In the former place I found in it one of its characteristic fossil shells, Tellina grœnlandica.

All the beds above referred to belong to the close of the tertiary period, and they are all marine; but they may have been deposited at distant intervals of time, and in waters of very various depth and area. The climates and other physical conditions appertaining to the times of their deposition, may have been different from each other and from that which now prevails. On these subjects the best evidence that we can obtain is that of fossil remains. We may therefore proceed to consider these, as they exist in different localities and at different levels; and first with reference to the lower level referred to, that of the plain or terrace at the height of 100 to 120 feet above the river.

At and near the Tanneries, shells are found in superficial sand, and also in tenacious gray and reddish clay underlying it. In the former and at the surface of the latter, the prevailing shell is Saxicava rugosa, along with which Sir C. Lyell mentions Mytilus edulis, which I have not yet seen at this place. These may be regarded as in this latitude littoral or shallow water shells. In the clay the only abundant shell is Nucula (Leda) Portlandica. This, judging from the habits of its modern congeners, must be a deep sea shell, inhabiting quiet muddy bottoms at from 10 to 50 fathoms in depth, or perhaps still lower.*

At this place then there appears to have been a shallow water or littoral deposit, superimposed on one that must have been deposited in deeper water. Under both is the boulder clay.

In the grounds of McGill College, the excavations for the main pipe of the water work, have exposed an interesting section of

* Living specimens of Nucula tenuis and Yoldia lucida have been dredged from a depth of 200 fathoms on the coast of Norway by M'Andrew & Barrett.

these deposits. The overlying sand is here of a light yellow color; the clay below very fine and unctuous, and of a grey colour. Both contain a few large boulders, and are underlaid by boulder clay, which toward the base of the mountain, comes up to the surface. In some places the top of the clay is cut into deep furrows filled by the sand, but in others the latter rests on an unbroken surface, and a layer of greyish sandy clay forms a transition between them. The sand contains no shells. The thin transition bed of sandy clay abounds in the following species, arranged as nearly as possible in the order of their relative abundance:—

Tellina Groenlandica.
Saxicava rugosa.
Mya arenaria.
Mytilus edulis.
Astarte Laurentiana.
Tellina calcarea.
Trichotropis borealis.
Fusus tornatus.
Bulla oryza.
Leda Portlandica.

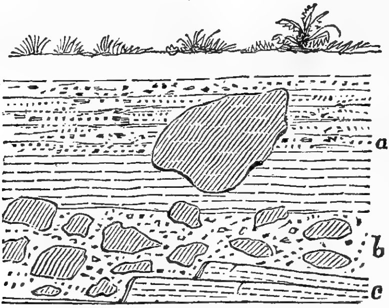
In the clay below, very few shells occur; and these exclusively Leda Portlandica and Astarte Laurentiana; which are found principally in its upper layers, and have their valves attached. Here again we have evidence of a deep sea bed overlaid by one that is littoral; and it is also worthy of notice that the two species found in the former are not now known as American shells, at least in this latitude; while those in the upper bed are common American species. For convenience we may name the upper bed the *Saxicava Sand*, and the lower the *Leda Clay*. (See Fig. 1.)

At the cutting of the Montreal and Ottawa railway near St. Denis street, and at the brick yards, the Leda clay and Saxicava sand occur as before. From the latter of these places Sir W. E. Logan has obtained a number of caudal vertebrae of a cetacean and part of the pelvis of a seal, as well as fragments of wood of the common American cedar (Thuja occidentalis). These remains were apparently contained in the Leda Clay.

At the Mile End quarries, the limestone has in places a thin coating of boulder clay, over which are stratified sand and gravel, with layers of shells in the lower part. This place is on the summit of a slight ridge, and the thick fine clay of the brick-yard

and Sherbrooke Street, has apparently not been deposited on it, or has been swept away, so that the littoral sand and gravel rest immediately on the boulder clay, and in some places on the rock. (*See Fig.* 2.)

Fig. 2.



a Stratified Sand and Gravel with marine shells, and a large boulder. *b* Hard Boulder Clay. *c* Silurian Limestone.

The following is the assemblage of shells at this place :

Saxicava rugosa, (by far more abundant than any other.)
Mya truncata.
Tellina Groenlandica.
Astarte Laurentiana.
Mytilus edulis.
Mya arenaria.
Tellina calcarea.
Balanus crenatus. (Bal. miser of some lists. It is usually attached to the mussel shells.)
Trichotropis borealis.
Bulla oryza.
Natica clausa.
Spirorbis sinistrorsa, (attached to stones and loose valves of Mya Truncata.

All these may be regarded as littoral, or circum-littoral shells, the deep sea deposit being here absent.

Between the slight ridge at the quarries, and another near the house of James Logan, Esq., produced by a thick dyke of trap, is a slight depression, in which excavations for drains have exposed the richest collection of Post Pliocene shells that I have anywhere seen. In this flat, there occur sands with purely littoral shells, as Mytilus edulis, Mya arenaria, &c., and sandy clay with

a variety of other species, inhabitants, at least in part, of deeper water; but I could not certainly ascertain the superposition of these beds. I presume that it is, in descending order; littoral sand, sandy clay deposited in deeper water, a thin layer of deep sea clay, and boulder clay.

At this place, in addition to all the species already noticed, I have found:

Buccinum ciliatum.
Buccinum undatum.
Admete viridula.
Acmæa cæca.
Nucula minuta.
Lacuna neritoides.
Natica helicoides ?
Fusus scalariformis.
Serpula vermicularis
Margarita arctica.
Modiolaria discors.
Rissoa minuta.
Trichotropis arctica.
Cytheridea Mulleri ?

All these mollusks and articulates are known as inhabitants of modern seas, and most of them are boreal or arctic species.

In addition to these, there are at this place several species of Foraminifera, very abundantly distributed in the clay, and masses of silicious spicula of a sponge (Tethea). These sponges have evidently abounded in this quiet depression, and being covered by clay, their spicula have, on the decay of the animal matter, been imbedded in situ, so that at first sight they look little masses of asbestus, for which, indeed, they have been mistaken.

The large number of additional species collected at this place, shows that much may be done in adding to the fauna of this period. The circumstance which has favoured the accumulation here of so many species, is apparently the sheltered situation of this little hollow, and the deeper water in its bottom, as compared with that on the neighbouring ridges; on which, however, many of the shells may have lived, and may have been drifted into the intervening trough, so that we have here the inhabitants of different depths, or perhaps, more properly, a very rich spot of the sea bottom representing the laminarian zone intermediate between the purely littoral and coralline belts, but in its upper bed tend-

ing to the former, and in its lower part to the latter. The more fossiliferous part of the clay at this place, may thus represent a depth intermediate between that of our Saxicava sand and that of our Leda clay.

In many parts of Lower Canada, sea shells occur at the same level as those above described, and in similar beds, but not having examined them, I am not prepared to say much as to their bathymetrical conditions.

The celebrated locality of the capelin and lump-sucker, at Green's Creek on the Ottawa, appears to belong to this level, its elevation being 118 feet above Lake St. Peter.* The shells that I have seen from this place are littoral, principally Mytilus edulis and Saxicava rugosa, but I have been favoured by Sir W. E. Logan with the inspection of a collection of the nodules found in the clay at this place, among which is one containing Leda Portlandica, and the young of another resembling Leda pygmaea, in a tuft of delicate seaweed, in which they may have been drifted to the shore. In another of these nodules are the remains of an organism which appears to have been a star fish of the family Ophiuridae. Other nodules contain seaweeds of several species, and leaves of land plants, which will be noticed in the sequel.

The locality at Beauport, near Quebec, rendered classic by Captain Bayfield and Sir C. Lyell, belongs to this same level, and has afforded the following species not hitherto found at Montreal, beside many of those above enumerated.

Natica Groenlandica.
Natica heros.
Turritella erosa.
Scalaria Groenlandica.
Littorina palliata.
Cardium Groenlandicum.
Cardium Islandicum.
Pecten Islandicus.
Rhynconella psittacea.
Echinus granulatus.

I infer from the sections given by Lyell, Bayfield, and Emmons, that there may be at Beauport, as at Montreal, a distinction between the beds containing oceanic and deep sea shells,

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* Mr. Murray, Reports of Geological Survey.

as Rhynconella psittacea and Pecten Islandicus, and those containing Saxicava rugosa and other littoral shells. It is also observable that the shells occurring at Beauport and not at Montreal, are more of an oceanic character than those of the latter locality ; and this may, perhaps, be connected with the vicinity of the open sea at Quebec. Sir W. E. Logan informs me that the Beauport locality seems to be at the entrance of an ancient inlet. This would account for a mixture of shore and sea shells.

We may next direct our attention to the shore limits of the waters in which the shells of our one hundred feet level lived. It is evident that if in a given locality a bed occurs containing deep sea shells, say indicating depths of 20 to 50 fathoms, and another containing littoral shells, we must suppose that the shores appertaining to these two beds must have been very different, if, as we have every reason to suppose, the country was elevated and depressed en masse. In the Saxicava Sand, strictly littoral shells, as Mya arenaria and Mytilus edulis, are found with both valves attached, and apparently in situ, at a height of about 100 feet above the river. and at the base of the mountain. A sea level of this elevation would reach in a long bay up the Ottawa as far as Ottawa City. On the St. Lawrence it would not extend above the rapids, and south of the river it would reach but a short distance from the bank, except along the vallies of tributary streams. It would open into the Gulf of St. Lawrence by a strait of no great width. The sea area so characterized would be but a limited upward extension of the Gulf of St. Lawrence, not communicating directly with the ocean, receiving much fresh water, and subject to no ice drift, except that originating on its own shores. In such a basin the Mya arenaria and truncata, Mytilus edulis, Tellina groenlandica, and Saxicava rugosa, would find sufficiently congenial haunts, though their size might, as we find in some of the localities, be dwarfed by access of fresh water, or the extreme changes of temperature. In such a basin also, there might be deep channels affording passage to the tides, and containing shells of more oceanic character, and these might be expected to abound most toward the open sea on the north east. Locally there would be gravelly beaches, muddy inlets, sand banks, and deep oosy hollows, in each of which different species might predominate.*

* All these conditions may be observed in the bottom of the present Gulf of St. Lawrence, and in its quieter depths there are beds of clay closely resembling the Leda clay of this paper, and inhabited by two species of that genus of shell-fish.

If the land were slowly rising, so as to narrow the basin and limit the supply of sea water, species previously abundant might be diminishing in size and numbers; and in places storms and inundations might shut up shoaling bays, and inclose and destroy marine fishes frequenting such spots, entombing their remains along with those of sea weeds and of leaves of land plants drifted or blown from the shore. During such elevation, also, the positions of beaches, sand banks, and muddy bottoms, would be continually changing, so that similar alternations of argillaceous and coarse beds might be found at very different levels.

Such I suppose to have been the condition of the latest of the newer Pliocene, or post Pliocene sea areas of this part of the St. Lawrence valley, represented by the littoral sand and gravel of the lowest terrace or plain.

The clay which underlies this plain is of greater age, and is characterized by one deep sea shell which may represent a depth of from 100 to 300 feet or more, or a shore level of 200 to 400 feet above the river. We should, of course, expect to find the littoral shells belonging to this sea bottom at a higher level on the mountain, and at a greater distance from the river on the surrounding high lands.

Two of the most strongly marked terraces on the mountain occur at heights of 220 and 386 feet above Lake St. Peter. On these no shells have been found. If they existed, they have perhaps been swept away by land floods, or by the recession of the waters. Westward of Montreal, Sir W. E. Logan reports that gravel, sand and littoral shells occur near Kemptville on the Prescott Road, at an elevation of 250 feet above Lake St. Peter. Another locality in Winchester is 300 feet high, another in Kenyon 270 feet, and two others in Locheil 264 and 290 feet. Sand and shore shells occur at Hobbes Falls, Fitzroy, at a height of 350 feet. At Dulham Mills on the De L'Isle, according to Mr. Murray, shells occur at a height of 289 feet above the St. Lawrence. Eastward of Montreal, Mr. Barnard, C. E., informs me that shells occur in gravel, near Upton Station, on the Portland and St. Lawrence railroad, 257 above the St. Lawrence, and in circumstances indicating shallow water. Still further to the east and north, on the River Gouffre, near Murray Bay, Sir W. E. Logan found two terraces with littoral shells at heights of 130 and 360 feet above high water level. The first probably corresponds to our 100 feet level at Montreal, the latter to one of the higher shores above mentioned.

These facts, to which many others might probably be added, from the Reports of the Geological Survey and other sources, rudely mark out parts of the shores of a larger and older gulf probably contemporaneous with the newer portion of the Leda clay of the lower plateau. In this condition of the St. Lawrence Valley, it would still be a land locked gulf, and while we might expect shore ice and breakers to mix many boulders with the gravel at its margin, only a few large stones would be dropped into the clay in its deeper parts by drifted ice cakes. The Leda clay, for this reason, contains few boulders.

There are, however, still higher terraces on the mountain: and one of these 470 feet above Lake St. Peter, contains shells, and is the highest fossiliferous deposit of this period known in Canada. This beach is best seen on the property of D. Davidson, Esq., above Cote des Neiges. It has been well described by Sir C. Lyell, who recognized at once its littoral character. An excavation kindly made for me by the proprietor, shows the following succession, in descending order:

1. Angular stones and sand 8 feet.
2. Fine gravel, with inclined layers of shells, principally Saxicava rugosa, $5\frac{1}{2}$ feet.
3. Stratified Sand, few shells, 6 feet.

These beds are of very limited breadth, and rest against the steep side of the mountain, fronting the mouth of the Ottawa. They are evidently the remains of a beach thrown up at the mouth of a little cove or perhaps strait, intervening between the greater and lesser summits of the mountain, which must then have been rocky islets of very small size.

The sea that washed up this beach may have reached the escarpment of Niagara, and communicated with the ocean over the whole of the lower lands of Lower Canada and New England. It was, however, limited on the North by the high lands extending along that side of the St. Lawrence Valley; and on the Ottawa, in the 4th concession of Nepean, Sir W. E. Logan has observed a similar beach at a height of 410 feet. On the west, the highest terrace observed by the U. S. Geologists on the south side of Lake Ontario, appears to correspond with this sea level; and the gravel and sands containing elephantine remains near Hamilton, may have been washed into its western extremity from the neighbouring land. It does not appear, however, that marine shells have yet been found west of Kingston.

I know little of the fauna of this older sea area. The locality above referred to affords only Saxicava rugosa, Mya (fragments), Mytilus edulis, Tellina Grœnlandica; and we do not certainly know that even the Leda inhabited the deep sea bottom around Montreal at this time, since the lower part of the Leda clay appears destitute of fossils. It was then over 60 fathoms under water, and probably not tenanted by many animals. The waters of this sea must have been traversed by the arctic currents, ice laden in the spring, and its northern shores probably had a climate of as low mean temperature as that of Labrador, though perhaps less extreme.

At a still earlier period than that indicated by the beaches last described, the waters had been far higher; for large boulders of laurentian rocks are found on the summit of the mountain, and much higher than this on the sides of the mountains of the Eastern Townships and of New England. The limited seas therefore in which the marine fossils above named lived, were preceded by a state of things in which an extensive oceanic surface was spread over North America, and probably only a few isolated peaks and ridges projected above the waters. Of the shores of this ocean and the animals that may have lived near them, I know nothing; and the sea deposit corresponding to this period is the lower part of the Leda clay and the surface of the great bed of boulder clay below it, neither of which have afforded fossils.

I have not as yet referred to this lower member of the formation, and I have nothing new to offer in relation to it. All my observations, whether in Nova Scotia or Canada, incline me to adhere to the view long advocated by Sir C. Lyell, and recently very ably illustrated by Professor Hitchcock,* that the true boulder clay has resulted from the gradual subsidence of the land under the influence of a cold climate, producing a deposit along the shores, resulting from the joint action of ice and water; and this, as the land sunk, spreading itself over the whole surface. As an additional fact confirmatory of this view, I may mention the appearance of successive ridges presented by the surface of the drift, and the linear distribution of stones in it, where it approaches elevated land. These appearances are often observable in cuts made in the drift in the vicinity of Montreal. This explanation of course implies that the land whose elevation we have

* Smithsonian Publications, 1856.

been considering, had previously to the beginning of the Post Pliocene period sunk below the waves. Its subsidence must have been very slow, to give time for the accumulation of so thick a bed of travelled stones and clay; and that its re-elevation was also slow is evidenced by the cliffs cut by the waves, the beds of clay and sand deposited, and the multitudes of shellfish which lived and died during the process.

These stupendous changes of level, however slow, must have caused great vicissitudes of climate, and must seriously have affected animal and vegetable life, both on the land and in the sea. If, as seems probable, before the great boulder period subsidence, the land had attained its present extent and elevation, the climate might have resembled that which now prevails. As the land sunk, its climate would become less extreme, but of lower mean temperature, and the opening up of easier access to the arctic currents might greatly reduce the temperature of the sea. This would be especially the case, if, as seems probable, the loss of land was greater in the south, and extensive tracts remained above water in the north, producing quantities of drift ice.

The fossils correspond with such views. All the species, so far as determined, except one or two, are still living, and most of them in this latitude, though there is a prevalence of the more northern forms, and an absence of many species now extending as far north on the American coast. This conclusion was announced by Sir C. Lyell as far back as 1839, and it is confirmed by the species since found, which are stated by Dr. Gould of Boston, to form on the whole, a sub-arctic assemblage. Sir C. Lyell says, (Geol. Trans., 1839) "It is very probable that in the period immediately antecedent to the present, the climate of Canada was even more excessive than it is now, and that the shells resembled still more closely that small assemblage now found in high northern latitudes." Dr. Gould, in a letter to the author, says in reference to the group of additional species lately discovered : "Its character is sub-arctic, like that of Behring's Straits, Kamtschatka and Greenland." This character of the fauna corresponds with the indications of ice afforded by the presence of boulders, with the low mean temperature likely to result from a great depression of the land, and with the southward extension of the Arctic Ocean, and the great facilities thus afforded for the migrations of Arctic species both in longitude and latitude. On the other hand the resemblance of this fossil fauna to that of the American seas in modern

times, is increased by the direction of the present arctic currents, which give a boreal character to the marine fauna of Eastern America, as far south as Cape Cod.

In conclusion of this part of my subject, I may state that the precise limitation of the sea basins that occupied the St. Lawrence valley is of very great geological interest, when taken in connection with the conditions of life indicated by the fossils. The extension of observations on the fossils and the beds in which they are contained, is therefore very desirable; and I beg to invite to it the attention of observers. All the localities of the marine fossils should be observed, with the elevation and nature of the beds containing them. Any remains of land animals or plants imbedded with the shells would be of especial interest. Facts and specimens bearing on these points will always meet with attention if sent to the Geological Survey, to the author, or to the editors of this journal for communication to the Natural History Society.

I now proceed to give a list of the fossils found in these deposits; and as an aid to other inquirers, and a basis for future additions which I hope to make, I have thought it desirable to include not only the species recently obtained or identified by myself, (amounting to about 30, and indicated in the list by asterisks), but those previously known, with references to published figures and descriptions, synonymy, and new facts as to distribution in recent seas. Figures are also given of a few species not previously figured from this formation, or presenting peculiarities of interest.

I have to acknowledge the aid received from Dr. A. Gould, of Boston, who has kindly employed his extensive knowledge of American shells, in determining several species which I had not the means of identifying. Bathymetrical facts are given chiefly on the authority of Stimpson, ("Marine mollusks of New England"). Littoral extends to low water mark; Laminarian to 15 fathoms; Coralline to 50 fathoms; Deep Sea Coralline to 100 fathoms.

List of Canadian Tertiary Fossils.

(Species marked thus* have not been previously published as Canadian Fossils. (Lit.) denotes littoral, (Lam.) Laminarian; (Cor.) Coralline; (D. S. Cor.) Deep Sea Coralline; (C. G. S.) Collection of the Geological Survey of Canada.)

VERTEBRATA.

Phoca—Species not determined. Bones of posterior extremities, discovered by Mr. Billings, at Green's Creek, Ottawa, and

described by Prof. Leidy, Proc. Ac. Sci., Phila., April, 1856. Figured in Canadian Naturalist, Vol. 1. Also portion of a pelvis in C. G. S.

Cetacean—Species not determined; obtained by Sir W. E. Logan from clay near Montreal. Vertebræ in C. G. S.

Mallotus Villosus.—Capelin: Nodules from Green's Creek, in C. G. S., &c.

Cyclopterus Lumpus (Lumpus Anglorum)—Lump sucker. Nodules from Green's Creek, in C. G. S.

**Cottus*—A small fish from Green's Creek, found by Sheriff Dickson, of Kingston; imperfect, but probably of this genus.

MOLLUSCA.

(*Gasteropoda.*)

**Bulla Oryza*, Totten, (Fig. 3) Montreal, base of Saxicava Sand; rare, but of larger size than recent specimens. Recent on American coast, Maine and southward (Lit).

**Bulla Debilis*, Gould, (Fig. 4) Montreal, Logan's Farm. A single small specimen, with a visible spire, apparently referable to this species. It may be the young of the species figured by Emmons in the New York reports, and it much resembles B. Regulbiensis of Wood's crag Mollusca.

Buccinum Undatum, Lin. The specimens found at Montreal, St Nicholas and Beauport, and referred to this species, differ very much from recent specimens whether British or American. The body is much smaller in proportion to the spire, which is more elongated. The shell is much thinner, its revolving striæ finer and more uniform, and its transverse folds less distinct or absent. It always has one or more strong revolving ridges, giving in some specimens an angular appearance to the whorls. It resembles in form but not in markings, the variety figured by Sowerby (Min, Con. Tab., C X.) as B. elongatum, and also, though less closely. the variety læviusculum of Wood's crag Mollusca. It corresponds more nearly with the description of B. Donovani, Gould, If not as I suspect, a distinct species from B. Undatum, this shell must be a delicate variety produced by a muddy bottom and sheltered inland situation, a kind of habitat in which I have not seen the living B. Undatum. I trust to obtain a more complete suite of specimens to determine this question (Lit to Cor.)

**Buccinum ciliatum*, O. Fabr., (Fig. 5), Logan's Farm, Montreal. This species now lives on the American banks, also in

Greenland. Fossil in British pleistocene. Specimens found in Montreal are of small size (Cor.)

**Fusus tornatus*, Gould. Montreal, between Saxicava sand and Leda clay. This shell I suppose to be the F. Carinatus of the lists; but Dr. Gould assures me that it cannot be referred to that species, nor to the F. despectus of Linnæus, nor does it correspond precisely with any of the varieties of the Trophon antiquum of Wood's crag Mollusca, but it is evidently closely allied to that species. It corresponds exactly with Dr. Gould's description and figure*, and with recent specimens collected in Gaspé by Sir W. E. Logan. I have about 50 specimens, and they present no well marked variety of form. Recent on American banks (Cor).

**Fusus scalariformis*, Gould, (Trophon Scalariforme, Wood); very rare in Montreal, with F. tornatus. Recent Massachusetts Bay and northward; also in Spitzbergen, Behring's Straits and North Sea. Fossil in British crag. (Cor. and D. S. Cor.) (Fig.30.)

**Fusus* (Trophon) *harpularius*, Couthouy. Two specimens in the collection of the Geological Survey, correspond with this species. Recent in Massachusetts Bay. It closely resembles Clavatula castanea of Wood's crag Mollusca.

Trichotropis borealis, Brod. and Sow. Abundant at Montreal in Saxicava sand. Recent Cape Cod and northward, also in British crag. (Cor).

**Trichotropis arctica*, Middendorff. (Fig. 27) A single specimen found at Logan's farm, Montreal, is referred by Dr. Gould to this species, figured as Cancellaria arctica in the Malac, Rossica, and found recent at Behring's Straits.

**Admete* (*Cancellaria*) *viridula*, Stimpson (Fig. 6) (C. Costellifera, Wood's crag Mol). Montreal, with Fusus tornatus, &c. Larger than recent specimens, but resembles, according to Dr. Gould, large specimens figured by Middendorff. Recent Cape Cod and northward. Fossil in British crag. (Cor.)

Velutina zonata, Gould, (Fig. 10,) (V. Undata? Wood's crag Mol.) A single specimen from Logan's farm Montreal, given to me by Arthur Ross, Esq., appears to belong to this species. It is probably the same with that mentioned by Sir C. Lyell without specific name. Recent Massachusetts Bay and northward (Cor.)

Natica clausa, Brod. and Sow (Fig. Can. Nat., Vol. 1.) Plen-

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*The figures given by Sir C. Lyell, Prof. Emmons, and in Can. Nat. Vol. 1, represent small specimens with the lip broken.

[illegible] Mouth of [illegible] between [illegible] I suppose to be [illegible] referred to [illegible] specimens [illegible] with many of the varieties of [illegible] already [illegible] with Dr. Gould's [illegible] collected [illegible] present [illegible] (Cer.)

[illegible]

[illegible] Cape Cod and northward; also in [illegible]

[illegible] (Fig. 271). A single specimen [illegible] Russia, and [illegible]

[illegible] &c. [illegible] according to Dr. Gould, [illegible] specimens [illegible] Cape Cod and northward. [illegible] British [illegible]

[illegible] A single specimen [illegible] given to me by Arthur [illegible]

[illegible]

tiful at Montreal and Beauport in Saxicava sand; of very large size at Logan's farm. There are two distinct varieties, one corresponding to the typical N. clausa (see Fig. in Can. Nat., Vol. 1), the other possibly identical with N. Occlusa of Wood's crag Mol., which it resembles in its more elevated spire and thinner lips. Recent from Cape Cod and northward; Fossil in British crag (Cor.)

**Natica helicoides*, (?) Johnston, (Fig. 24,) The specimens represented by Fig. 24 correspond so closely with N. helicoides, as described and figured by Wood, that I had ventured to give them that name; but Dr. Gould, though he considers the shell distinct from N. Clausa, thinks it cannot be identified with the recent N. helicoides as described by Forbes, &c., unless indeed a larger number of specimens should connect it with that species as a very decided variety. These specimens differ from N. Clausa in their deeply channeled suture, open though small umbilicus, prominent inner lip and distinct revolving lines. The shell has evidently been of a more dense texture and less easily weathered than that of N. Clausa.

**Natica Grœnlandica*, Beck,This shell occurs in some specimens collected by Rev. Mr. Kemp at Beauport. Recent Cape Cod and northward (Lam. to Cor.)

**Natica Heros*, Say. A shell collected by Rev. Mr. Kemp, at Beauport appears to belong to this species. Recent American coast (Lit.)

**Menestho* (Chemnitzia) *albula*, Möller, (Fig. 7.) Some shells in the Col. of the Geological Survey appear referrable to this species, though much larger than recent American specimens. They resemble the shell figured by Emmons as Turritella. Recent Cape Cod and northward (Lam. to Cor.)

Scalaria Grœnlandica, Gould, (Fig. in Can. Nat., Vol 1,) Beauport, but not yet found at Montreal. Recent Massachusetts and northward. Fossil in British crag (Cor. to D. S. Cor.)

**Turritella erosa*, Couth, (Fig. 8.) Fragments from Beauport, larger than recent specimens. Recent coast of N. England (Cor. to D. S. Cor.)

**Rissoa minuta*, Stimp.—Found in interior of larger univalves at Montreal. It is difficult to secure such small and fragile shells in a perfect state, and I am therefore not quite confident of the species. Recent on American coast, (Lit.)

Littorina palliata, Say. In Lyell's list of Beauport shells.

I have received a specimen from Chicoutimi, Gaspé, from a littoral deposit a few feet above the level of the high tide, containing Saxicava rugosa, Balanus hameri, and Natica clausa. Recent American coast, (Lit.)

**Margarita Arctica*, Gould, (M. helecina, Moll,) Montreal with Fusus, &c. Some of the specimens are of large size and may be detected even when in fragments by their pearly appearance. Recent Cape Cod and Northward, (Lit. Lam.)

**Lacuna neritoidea*, Gould. A single specimen with Fusus, &c., Montreal. Recent on New England coast.(Lit. Lam.) (Fig. 29.)

**Acmaea*, (Propilidium,) *Caeca*, Mon. (Fig. 9.,) (P. Candida, Couthouy,) Montreal, with Fusus, &c. The specimens are of larger size than recent. This is probably the shell figured in N. Y. Reports as Patella. Recent Cape Cod and northward, also Greenland, Finmark, Spibergen. (Coral., D. S. Cor.)

**Amicula vestita*, Gray. (Fig. 24.) (Chiton Emersonii, Gould.) With Fusus, &c., at Montreal. Recent Cape Cod and northward. (Cor.)

Acephela.

Saxicava rugosa, Lam. (Fig. Can. Nat. vol. 1.) This is the most abundant shell in the littoral deposits at Montreal, Beauport, &c. Though not strictly a littoral shell, it was probably driven to the beach by breakers acting on the stony bottom of drift, or on the ledges of shale and limestone, in which it sheltered itself. At Beauport the size is small, and this is also the ease at Green's Creek, and the higher levels at Montreal; but at Logan's Farm and at St. Nicholas, these shells are as large as any modern specimens that I have seen. On the surfaces of drift and Leda clay, this species seems, as on the American coast at present, to have sheltered itself among stones and in patches of sea weed and mussels; but from the abundance of perforated pieces of limestone, I suspect that it also burrowed in the softer submerged ledges, and that this may account in part for its great abundance. At present this shell is generally distributed over the North Atlantic. It ranges from low water to great depths, and is of larger size in the Arctic Seas and in deep water.

Mya arenaria, Linn. Abundant at Montreal; but always of small size, rarely more than half the size of recent shells from the gulf of St. Lawrence; but there are in C. G. S. very large and thick specimens from a raised beach at Riviére du Loup. (Lit.)

Mya truncata, Linn. (Fig. Can. Nat. vol. 1.) More abundant and larger at Montreal than M. arenaria. Recent American Banks. (Lit. to Cor.)

Tellina Grœnlandica, Beck. (Fig. Can. Nat. vol. 1.) Very abundant in Saxicava sand, Montreal, &c. Recent in Arctic Seas, &c. Fossil in British Pleistocene. I suppose it identical with the T. fusca, recent in gulf of St. Lawrence. (Lit. Lam.)

Tellina calcarea, Lyell. (Fig. Can. Nat. vol. 1.) Probably T. Proxima and sordida of American authors. Less abundant than the preceding species at Montreal, very plentiful at St. Nicholas. Recent Cape Cod and northward. (Cor.)

Astarte Laurentiana, Lyell. (Fig. Lyell's Elements and Can. Nat. vol. 1.) Common at Montreal in Saxicava sand and less so in Leda clay, supposed to be extinct, but closely allied to A. Sulcata, recent.

Cardium Islandicum, Lin. Beauport. (Lyell.) Cape Cod and northward. (Cor.)

Cardium Grœnlandicum, Gould, Beauport. (Lyell.) Cape Cod, &c. (Cor.)

Leda Portlandica, (L. truncata Wood's Crag. Mol.) Characteristic of the Leda clay, Montreal. Rare in Saxicava sand. Fossil in British crag, and recent in Arctic Seas, if identical with L. truncata; but Dr. Gould after examining a suite of very perfect specimens from Montreal, thinks it distinct from any recent species known to him.

**Leda pygmaea*, Wood, (Fig. 11.) A few small specimens entangled in a delicate sea-weed, in a nodule from Green's Creek in C. G. S., have the form of this or some closely allied species.

**Leda minuta*, Gould, (Fig. 12.) Rare at Montreal. Dr. Gould says: "I think our L. tenuisulcata, Couthouy, a different species; but I have a specimen from our northern seas corresponding with this fossil, and with one sent by Dr. Loven, from Scandinavia as L. minuta." I suppose this to be the L. caudata of Wood's Crag. Mol. (Cor.)

Mytilus edulis, Lin. (Fig. 13.) Common at Montreal in Saxicava sand. It differs from the common recent varieties in its obtuse beaks, short rounded hinge line, oval outline, strongly marked and coloured lines of growth, and small size. Fig. 13 is the common form at Montreal. It resembles the var. elegans of Wood's Crag. Mol. Recent north Atlantic. (Lit.)

**Modiolaria, discors*, Lin. (M. discrepans, Montagu.) A single

specimen found with Fusus, &c., at Montreal. Being a pearly shell it crumbles and can scarcely be preserved entire. Dr. Gould remarks:—"The synonymy is not quite clear; a very different shell has usually been held for M. discors. Neither M. discors nor discrepans of Gould is this shell; but M. nexa is the young. It is figured by Beck in Gaimard Voy. en Iceland et au Greenland, as M. striatula. A northern shell."

Pecten Islandicus, Mull. (Fig. Can. Nat. vol. 1.) Beauport. Recent Connecticut and northward. Fossil British Crag, (Lam. and Cor.)

Rhynconella psittacea, Chemnitz, (Fig. Can. Nat. vol. 1.) Beauport. Recent Gulf St. Lawrence. Fossil in British Crag, (D. S. Cor.)

Articulata.

Balanus Hameri, Ascanius, (Fig. Can. Nat. vol. 1.) Beauport and St. Nicholas, not as yet at Montreal. This is the B. uddevallensis of Lyell's list, and appears to be the B. miser of the New York Reports. Fossil in European and British pleistocene; recent in British and American seas. I have a fine specimen with the animal from the coast of Nova Scotia. (Cor.) A deep water shell according to Darwin. Fig. 25 represents the opercular valves from St. Nicholas.

Balanus crenatus, Brug. Abundant at Montreal, &c. The variety elongatus is very plentiful, also the depressed variety. It is often attached to mussel shells and to pebbles in the stratified gravel. (Deep water,—Darwin.) As I am not aware that the opercular valves of this species have been previously found in Canada, I have represented a pair in Fig. 26.

Balanus porcatus, Da Costa. Darwin, in the Palaeontographical Society's publications, gives this as one of the Beauport species in Sir C. Lyell's collection.

**Cytheridea*, (Fig. 14.) At Logan's farm Montreal, with sponge spicula, &c. It resembles C. Mülleri (Münster), recent in the Zuyder Zee, fossil in the Pliocene of the Netherlands and in the Eocene of England, so closely that I have not much hesitation in referring it to that species: (see Jones in London Geological Journal, vol. x. 160.)

**Spirorbis sinistrorsa*, Montagne, (Fig. 15.) At Mile end quarries, Montreal, attached to shells of Mya truncata and to pebbles in stratified gravel. Recent George's Bank, (Cor.)

**Serpula vermicularis*, Lin. (Fig. 28.) A small specimen, Montreal, supposed by Dr. Gould to be this species.

RADIATA.

Echinus granulatus, Say. Found at Beauport by Sir C. Lyell. (Lamin.)

**Ophiura.*—In a nodule from Green's Creek in C. G. S., are the remains of an organism which appears to have been a star fish of the family Ophiuridae.

**Tethea*, Lamarck, (Fig. 16.) Silicious spicula, referable to sponges of this genus, abound at Logan's farm, Montreal, and as I am informed at other places in the tertiary clays, though they have hitherto been supposed to be of mineral origin. They occur in radiating flattened masses, just as they have existed in the living sponges, some of which must have attained a diameter of nearly three inches. They have either grown on the clay or attached to dead shells. The long cuticular spicula are $\frac{3}{10}$ths of an inch in length, slightly curved, pointed at both ends, and with a large internal cavity, which appears in the large as well as in the small specimens. Under a high power the points appear slightly truncated and open. The shorter internal spicula are about $\frac{1}{10}$th of an inch in length. Mr. Bowerbank of London, who has kindly examined these curious fossils, has no doubt that they belong to the genus Tethea; but does not refer them to any species. The spicula resemble the simple ones of T. Cranium, as figured by Johnston; but our fossils do not afford any that are tricuspidate. In the mean time, therefore, until this species can be identified with any previously described, I may claim for it, as one of the most curious fossils of these deposits, the name of T. Logani, in honour of the head of the Canadian Geological Survey, who has kindly placed at my disposal for this paper many of the materials he had collected for the description of these tertiary deposits, to which the pressure of more important departments of his work has hitherto prevented him from devoting much of his attention.

Mr. Bowerbank informs me that the recent species of Tethea range from low water mark to 200 fathoms.

**Foraminifera.*—The calcareous shells of several species of these minute creatures, occur with the sponges above mentioned. My means of reference do not permit me to refer them with any cer-

tainty to their species, though I presume they are all living forms; nor have I yet had time to examine all the specimens collected. Figs. 19 to 22 represent some of the forms observed. Fig 17 appears to be a Rosalina. Fig. 18 is probably the Quinqueloculina occidentalis of Bailey, obtained from the Atlantic soundings from a depth of 20 fathoms. Fig. 21 may be the widely diffused Orbulina universa, also found in the Atlantic soundings. Figs. 19 and 20 appear to be species of Polymorphina.

I might add to this list of animal remains, a Lymnea, apparently elodes, and a Cyclas, but I suspect them to be recent and accidental. The same remark applies to shells of Ostrea borealis occasionally found in the surface soil over the marine beds.

Plantae.

**Populus balsamifera*—Balsam poplar.—In a nodule found by Sheriff Dickson of Kingston, at Green's Creek, is a leaf of this species. Another, less perfect, is in C. G. S. This is a northern species widely difiused.

**Potentilla Norvegica.*—In a nodule from Green's Creek in C. G. S., is a leaf which, according to Prof. Barnston, cannot be distinguished from a cauline one of this species. This also is a widely diffused northern plant.

**Thuja occidentalis*—the common Cedar of Canada.—Branches in C. G. S., from brick clay pits near Montreal, show the structure of this species.

**Algae.*—In nodules in the C. G. S. are at least three species. These sea-weeds have been examined by Rev. A. Kemp, who states that one of them is apparently a stem of Laminaria, and that others are probably referable to the genera Fucus, Polysiphonia, and Porphyra, but that their state of preservation does not admit of accurate specific determination.

Nearly all the fossils in the above list have been obtained in beds belonging to the plateau, elevated about 100 feet above the St. Lawrence. Two of the species, Leda Portlandiea and Astarte Laurentiana, are characteristic of the stratified clay, and these are the only species which we have any reason to believe extinct. A number of recent species belong to the littoral sand and gravel, and several of these occur at all heights up to 470 feet. A very large number of species have been obtained from what I regard as the intermediate deposit of Logan's farm near Montreal.

At Montreal, then, we have a littoral group of shells, a group belonging to the Laminarian and Coralline zones, and a group probably belonging to the Coralline and deep sea Coralline zones. Perhaps the reason why the two shells characteristic of these last zones have not yet been recognised as recent, is that the deep sea muddy bottoms on the American coast, have not yet been well explored. It must be observed, however, that as the land was rising at the time when these beds were deposited, in the lower levels these three belts are stratigraphically superimposed on each other, and mark not only difference of depth but lapse of time. To what extent the precise order of these deposits, as observed at Montreal, may hold in other parts of the St. Lawrence valley is not yet known, but I hope to extend my observations with relation to this point; and from facts published by other observers, I have reason to believe that they will be found somewhat generally prevalent.

With respect to the divisions into which these deposits may be separable, the presence of recent shells alone in the upper beds, would refer them to the Post-Pliocene period, while on similar grounds the Leda clay and boulder clay might be regarded as Newer Pliocene. Strictly speaking, however, the whole formation belongs to the period of transition from the Pliocene to the modern epochs. The great boulder clay indicates a subsidence at the close of the former, and the overlying beds the conditions of deposit and of life during the re-emergence of the land; so that if we regard physical change as our guide, I should with several previous writers on the subject, consider the whole of the stratified beds overlying the boulder clay as one group of "modified" as distinguished from "unmodified" drift, a division which I long ago adopted for the non fossiliferous drift of Nova Scotia. This view would be farther strengthened by the probability that the high beaches containing recent shells may be contemporary with the low lying clays having species supposed to be extinct, and the farther probability that these last may yet be found living. In the meantime, therefore, I prefer to consider these deposits as extending through portions of the Newer Pliocene and Post Pliocene periods, without establishing any lines of division other than those stamped on the deposits in the locality to which this paper principally relates.

By the kindness of Arthur Ross, Esq. of Montreal, I have been favoured with a collection of fossil shells, from St. Nicholas, 15

miles above Quebec," on the south side of the St. Lawrence, at the head of a rocky ravine, 400 yards from the river, and 180 feet above its level." These shells belong to a level much higher than that which has afforded the greater number of the species at Montreal and Quebec. The assemblage is considerably different from that at other localities. Tellina calcarea predominates, and is of very large size, some specimens being 1½ inch in length. Balanus Hameri is a very abundant, and sometimes has its opercular valves. also Mya truncata, the latter of small size. The only other shells are Saxicava rugosa, and Astarte Laurentiana, Trichotropis borealis and Buccinum undatum. The matrix is stony clay. This deposit though at a considerable elevation, was probably formed in deep water.

As I observe in a note in the Edinburgh New Philosophical Journal for October, that Professor H. J. Rogers is still disposed to consider the shells found at a height of 470 feet on the Montreal Mountain, as having been "swept thither from a much lower level," I presume by earthquake waves; I think it necessary to add to the statements above given, that the shells occur only in stratified sand and fine gravel, alternating in thin layers precisely in the manner of a modern beach. The shells are of course not precisely in situ, being arranged in layers among the sand, but their arrangement indicates merely the ordinary action of the waves on the shores of a bay. The error of Professor Rogers may have been caused by his confounding the stratified fossilferous sand with the unstratified debris which overlies it, and which may perhaps indicate subsidence and ice drift subsequent to the formation of this beach. I think it more probable, however, that this overlying confused mass has resulted from the sobaerial waste of the steep slope above the beach. The existence of this incoherent terrace of sand and shells perched on a steep and exposed hill side, is one of the most convincing proofs that could be desired that no cataclysmal waves have swept over the Montreal Mountain since the sea stood at this level. It is proper to add that Sir C. Lyell, writing in 1845,* clearly distinguishes the stratified shell bearing beds from the unstratified mass above.

A very interesting collection of recent shells from the mouth of the St. Lawrence, has just been brought to Montreal by Mr. Bell, a young gentleman employed on the Geological Survey. It

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* Travels in North America, vol. 2.

i.cludes numerous specimens of Buccinum undatum, but none of them present the peculiarities of the fossil variety. Fusus tornatus is represented by a single specimen, quite similar to the fossil individuals. Natica heros is abundant, as are Mytilus edulis, Mya arenaria, Tellina groenlandica, Littorina palliato, and Pecten Islandicus. There is a single specimen of Tellina calcarea, said to have been found in brackish water at Bay St. Paul. Scalaria groenlandica, Mya truncata, Astarte Sulcata, and Cardium Islandicum are represented by single specimens. Balanus crenatus and a Spirorbis, apparently nautiloides, are attached to mussels and to Pecten Islandicus. Saxicava rugosa does not appear in the collection. Purpura lapillus, Mactra ovalis, Littori tenebrosa, Solen eusis and Mesodesma arctata, are numerous, though they have not yet been found in the tertiary clays.

The specimens of Mya arenaeia are large and coarse in comparison with those found at Montreal. The mussels have not the antique form. Tellina groenlandica has precisely the character of the fossils; and the more common variety, (Sanguinolaria fusca) is also represented by specimens said to have been found in brackish water.

The collection may be regarded as showing the prevalent shells, in that part of the gulf of St. Lawrence nearest to those ancient extensions of the same gulf described in this paper.

Other materials have been accumulating since the above paper was written; and I hope in some future number of the *Naturalist* to follow up the subject.

REFERENCE TO FIGURES.

Fig. 3.	Bulla oryza,	Montreal.
4.	Bulla debilis,	Do.
5.	Buccinum ciliatum,	Do.
6.	Admete viridula,	Do.
7.	Menestho albula,	Do.
8.	Turritella erosa (fragment),	Do.
9.	Acmaea caeca,	Do.
10.	Velutina Zonata,	Do.
11.	Leda pygmaea? nat. size and magnified,	Green's Creek.
12.	Leda minuta,	Montreal.
13.	Mytilus edulis (var. Laurentiana),	Do.
14.	Cytheridea (nat. size and magnified),	Do.
15.	Spirorbis sinistrorsa (nat. size and magnified),	Do.
16.	Sponge (Tethea Logani), (*a*) nat. size in situ, (*b*) spicules, (*cd*) large spicules magnified.	

17 to 22. Foraminifera (magnified), . . . Montreal.
23. Natica helicoides? . . . . . . Do.
24, Amicula vestita, two anterior valves, . Do.
25. Opercular Valves of Balanus Hameri.
26. Opercular Valves of Balanus crenatus, three times natural size.
27. Trichotropis arctica.
28. Serpula vermicularis.
29. Lacuna neritoidea.
30. Fusus scalariformis.

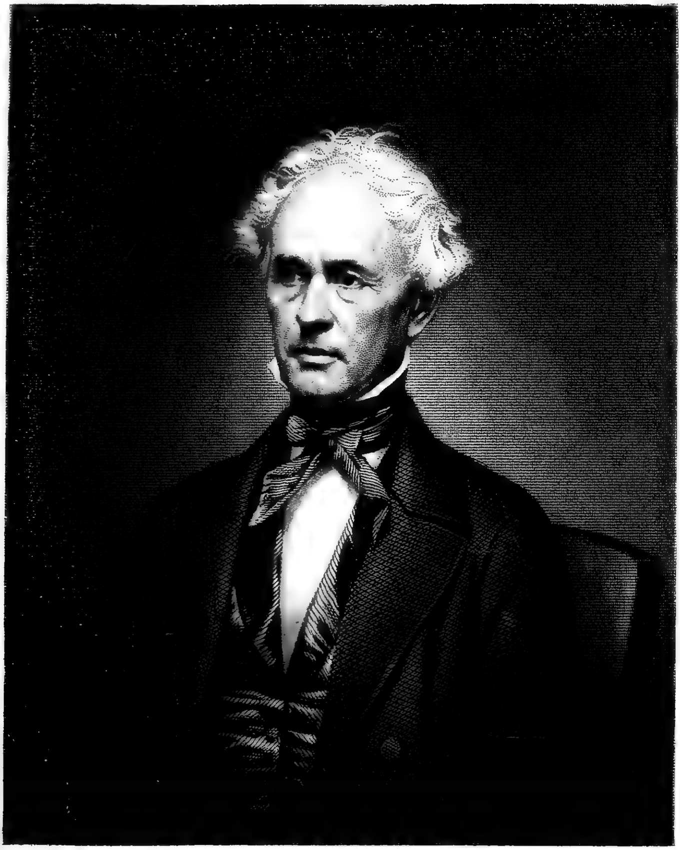
ARTICLE XXXVII.—*Biographical Memoir of William C. Redfield*; by Professor Denison Olmsted, L.L.D., of Yale College.

[From an Address delivered before the American Association for the Advancement of Science, at Montreal, August 14th, 1857.]

Gentlemen of the Association.

Since last we met, the Destroyer has been very busy in our ranks. Besides other beloved and respected associates, our earliest and our latest Presidents have suddenly vanished from our midst;—*Redfield*, who was the first to suggest the idea of the American Association on its present comprehensive plan, and the first to preside over its deliberations, and *Bailey* who, we fondly hoped, would occupy the same distinguished position on the present occasion. From the vision of both, as we humbly trust, the veil which permits us here to see only through a glass darkly, is removed, and the grand laws of Nature, and the infinitessimal no less than the infinite in God's works, are revealed to them in the clear light of heaven.

With Mr. Redfield my acquaintance has been long and intimate. I was conversant with his earliest researches on the subject which is so closely associated with his name, and I have been constantly a witness of his untiring self-sacrificing labors in the cause of science, through all the subsequent years of his life. I respected him as a man, I admired him as a philosopher, I loved him as a friend. We miss him here, always the earliest to come and the latest to depart. We miss his gentle tones, his kindly greetings. We miss still more the radiance which his clear mind cast upon our pathway up the hill of science. I am thankful for the opportunity of presenting before this learned assembly a



Yours truly

Wm C. Redfield

synopsis of his scientific labors. Some brief notice, also, of his personal history may be acceptable, not only as to satisfy the wishes of his friends, but for the benefit of his example, which, I trust, will especially commend itself to the self-taught votary of science, and to all who are engaged in the pursuit of knowledge under difficulties, both as an incentive and a model. A life passed in the ordinary walks of business, or in the quiet of philosophical research, affords little of that romantic incident which lends a charm to biography ; still we think the life of Mr. Redfield affords an interesting and instructive theme for contemplation in a three-fold point of view,—as affording a marked example of the successful pursuit of knowledge under difficulties, —as happily illustrating the union, in the same individual, of the man of science with the man of business,—and as exhibiting a philosopher, whose researches have extended the boundaries of knowledge, and greatly augmented the sum of human happiness.

William C. Redfield was born at Middletown, Connecticut, on the 26th of March, 1789. He was of pure English descent both by the father's and mother's side. His father from a natural love of adventure, chose in early youth a sea-faring life, and afterwards followed the seas as a profession to the time of his death, which happened when this, his eldest son, was only thirteen years old. His early training, therefore, devolved chiefly on his mother, who was a woman of superior mental endowments, and of exalted Christian character.

The slender pecuniary resources of the family would not allow young Redfield any opportunities of school education beyond those of the common schools of Connecticut, which, at that time, taught little more than the simplest rudiments—reading, spelling, writing, and a little arithmetic ; and all access to the richer treasures of knowledge seemed to be forever denied him, when, at the early age of fourteen, he was removed to Upper Middletown, now called Cromwell, and apprenticed to a mechanic, whose tasks engrossed every moment of his time except a part of his evenings. These brief opportunities, however, he most diligently spent in the acquisition of knowledge, eagerly devouring every scientific work within his reach. He was denied even a lamp for reading by night, much of the time during his apprenticeship, and could command no better light than that of a common wood fire in the chimney corner. Under all these disadvantages, it is evident that before he was twenty-one years of age he had acquired no ordinary

amount and variety of useful knowledge. During the latter part of his apprenticeship he united with other young men of the village in forming a debating society under the name of "The Friendly Association," with which was connected a small but growing library. To this humble literary club, Mr. Redfield always ascribed no small agency in inspiring him with a love of knowledge, and a high appreciation of its advantages; and during his future years, he nursed and liberally aided by his contributions this benefactor of his youth.

Fortunately for young Redfield, a distinguished aud learned physician, Dr. William Tully, fixed his residence in the same village, and generously opened to him his extensive and well-selected library; and what must have been equally inspiring to youthful genius, Dr. Tully furnished him with a model of an enthusiastic devoted to knowledge, and of a mind richly stored with intellectual wealth. The modest youth who first presented himself as a suppliant for the loan of a book from the Doctor's library, was soon recognized as a congenial spirit, and was admitted to an intimate friendship, which lasted to the day of his death. Dr. Tully has favored us with the particulars of his first acquaintance with our friend. On his application for a book to occupy such moments as he could redeem from his daily tasks, the Doctor, being then ignorant of his acquirements or his taste, opened different cases of his library, submitting the contents of each to his selection. Among a great variety of authors, that which determined his choice was Sir Humphry Davy's Elements of Chemistry. As this was one of the earliest systematic works that contained the doctrine of Chemical Equivalents, a subject then considered as pecularly difficult, and one understood by few readers of the work, the Doctor had little expectation that his young inquirer after knowledge, would either understand or relish it. In a short time he returned the book, and surprised the Doctor by evincing a thorough acquaintance with its contents, and expressing a high satisfaction, in particular, with the doctrine of chemical equivalents, which he said, he had then met with for the first time.

Some time before young Redfield reached the end of his apprenticeship, his widowed mother had married and removed to the state of Ohio. He was no sooner master of his time than he set out on foot to pay her a visit in her new home, distant more than seven hundred miles. It was a formidable undertaking, in

[illegible] knowledge. During the [illegible] he united with other young men of the [illegible] under the name of [illegible] connected a small but growing [illegible] the humble literary club, Mr. Redfield [illegible] and a moral agency in inspiring him with a love of knowledge, and a high appreciation of its advantages; and during his future years, he [illegible] and [illegible] aided by his contributions [illegible] of his youth.

[illegible] Redfield, a distinguished and learned [illegible] his residence in the same [illegible] his extensive and well [illegible] inspiring to [illegible] a model of an [illegible] richly stored [illegible]

[illegible] Redfield [illegible] favored us with the particulars of [illegible] On his application for a book [illegible] his daily tasks [illegible] a [illegible] taste [illegible] of such [illegible] a great [illegible] his choice was [illegible] Equivalents, [illegible] considered as peculiarly difficult and [illegible] understood [illegible] of the book the Doctor had little expectation [illegible] would either [illegible] Doctor [illegible] and expressing [illegible] of chemical equivalents, [illegible] the first time.

[illegible] before young Redfield [illegible] his widowed mother [illegible] the [illegible] of Ohio. He was [illegible] to [illegible] a visit to her new home, distant more than [illegible] It was a formidable undertaking, [illegible]

that early period before the age of steamboats and railways, and when a large part of the way was covered with dense forests, with hardly an open path even for the pedestrian. Stage coaches, indeed, ran on the nearer portions of the route, but these were too expensive for the slender finances of our young adventurer. Accompanied, therefore, by two other young men, he shouldered his knapsack and commenced the arduous journey. Every evening he noted down the incidents and observations of the day. This journal is now in my possession, and I have purused it with deep interest for the graphic sketches it contains of the countries he passed through, then mostly new settlements, and for the indications it affords of those powers of observation, which afterwards led to the development of the laws of storms. The style of composition is far superior to what might reasonably have been expected from one who had enjoyed so few literary advantages, evincing two qualities for which Mr. Redfield was always distinguished—good sense and good taste. The sketches of Western New York, and of Northern Ohio, taken while the sites of Rochester and Cleveland were dark and gloomy forests, and Buffalo was a mere hamlet, possess no ordinary degree of historical interest. Instead of a "Lake Shore" road, traversed by the iron horse, as at present, our young pedestrians could find no better paths in which to travel over the southern side of Lake Erie, than to course along the beach. Yet in twenty-seven days they made good their journey, having rested four days on the way, making an average of about thirty-two miles per day. After passing the winter with his friends in Ohio, he resumed his way homeward on foot and alone, returning by a more southern route, through parts of the states of Virginia, Maryland and Pensylvania. We shall soon see to what valuable account he afterwards turned the observations made on these early pedestrian tours, in tracing the course as well as originating the project, of a great railway connecting the Hudson and the Mississippi rivers.

Returning to his former home in 1811, Mr. Redfield commenced the regular business of life. No circumstances could seem more unpropitious to his eminence as a philosopher, than those in which he was placed for nearly twenty years after his first settlement in business. A small mechanic in a country village, eking out a scanty income by uniting with the products of his trade the sale of a small assortment of merchandize, Mr. Redfield met with obstacles which in ordinary minds would have quenched the

desire of intellectual progress. Yet every year added largely to his scientific acquisitions, and developed more fully his intellectual and moral energies. Meanwhile his active mind left its impress on the quiet community where he lived, in devising and carrying out various plans for advancing their social comfort and respectability, in the improvement and embelishment of their streets, school houses and churches, and in promoting the interests of the literary club, from which he himself, in early youth, had derived such signal advantages. From deep domestic trials which afflicted him about the year 1820, he had recourse for solace both to the word and the works of God. It was soon after one of the severest of these trials, that his attention was first directed to the subject of Atlantic Gales.

On the 3rd of September, 1821, there occurred, in the eastern part of Connecticut, one of the most violent storms ever known there, and long remembered as the "great September Gale." Shortly after this, Mr. Redfield being on a journey to the western part of Massachusetts, happened to travel over a region covered by marks of the ravages of the recent storm. He was accompanied by his eldest son, then a young lad, who well remembers these early observations of his father, and the inference he drew from them. At Middletown, the place of Mr. Redfield's residence, the gale commenced from the southeast, prostrating the trees towards the northwest; but on reaching the northwestern part of Connecticut, and the neighboring parts of Massachussetts, he was surprised to find that there the trees lay with their heads in the opposite direction, or towards the southeast. He was still more surprised to find, that at the very time when the wind was blowing with such violence from the *southeast* at Middletown, a *northwest* wind was blowing with equal violence at a point less than seventy miles distant from that place. On tracing further the course and direction of prostrated objects, and comparing the times when the storm reached different places, the idea flashed upon his mind that the storm was a *progressive whirlwind*. A conviction thus forced upon his mind after a full survey of the facts was not likely to lose its grasp. Amid all his cares, it clung to him, and was cherished with the enthusiasm usual to the student of nature, who is conscious of having become the honored medium of a new revelation of her mysteries. Nothing, however could have been further from his mind, than the thought that the full development of that idea, would one day place him among the

distinguished philosophers of his time. So little, indeed, did he dream of fame, that for eight or nine years after the first conception of his theory, he gave little attention to the study of the phenomena of storms, but was deeply engrossed in other enterprises which, although foreign to this subject, were alike evincive of his original and inventive turn of mind. Of these we may take a passing notice.

Before the scientific world, Mr. Redfield has appeared so exclusively in the character of a philosopher, especially of a meteorologist, that they have been hardly aware of the important services he has rendered the public in the character of *naval engineer*, particularly in the department of steamboat navigation. His attention was turned professionally towards this subject as early as the year 1820, when he became much interested in an experiment with a small boat propelled by an engine of new and peculiar construction, the invention of Franklin Kelsey, Esq., a townsman of his. Although the enterprise was not successful to the company, yet to himself it was not destitute of valuable results, as it was the occasion of his acquiring a more intimate knowledge of the properties of steam, of steam navigation, and of ship building. On the ruins of that enterprize was erected another, which after some vicissitudes acquired a permanent success, and opened to him a sphere of professional labor which constituted ever afterwards the leading object of his life, as a man of business. Several disastrous steamboat explosions had spread alarm through the community and created a general terror of steamboats. Redfield was the first to devise and carry into execution the plan of a line of *safety barges* to ply on the Hudson between New-York and Albany. The scheme was, to construct a passenger boat to be towed by a steamboat at such a distance from it as to avoid all apprehension of danger to the passengers. Large and commodious barges were built, fitted up with greater taste and luxury than had at that time been exhibited by steamboats. With these were connected two large and subtantial steamers; and in the excited state of public mind, these safety barges became great favorites with travellers, especially with parties of pleasure. But our countrymen never hold their fears long: a short interval of exemption from steamboat accidents ended the excitement, while the greater speed attained by the ordinary boats, and the lower fare, gradually drew off passengers from the safety barges, until they could be no longer run with profit to the company, and were

abandoned. But the idea was not without profit, for it suggested to him the system of *tow boats* for conveying freight, which was established in the spring of 1826, and still continues under its original organization. The fleets of barges and canal boats, sometimes numbering forty or fifty, which make so conspicuous a figure on the Hudson river, were thus set in movement by Mr. Redfield, and for thirty years the superintendence of the line first established, constituted the appropriate business of our friend. In its management he employed unwearied industry, superior mechanical genius for contriving expedients, and a knowledge of both the science and art of steam navigation possessed by few men of business. Seldom have we seen the inductive philosopher so happily united with the practical engineer, each character borrowing aid from the other. I know not that any other man connected with the management of a steam navigation concern as his profession ever carried into his business more of the spirit of true science, and it is chiefly on this account that I have thought it fitting to attend our associate into the familiar walks of business, for the purpose of seeing how compatible, and how productive of useful results is the happy union, in the same person, of the philosopher and the man of business. No one else could have so thoroughly connected the statistics of the professsion in this country, embracing all the facts relating to the explosion of steamboat boilers, as they successively occurred — the number of lives lost — the number of deaths by steam compared with those by lightning—and the number compared with those lost by other modes of travel. Moreover, while Mr. Redfield was diligently pursuing his daily business and conducting with success the affairs of the "Steam Navigation Company," he was also collecting facts for the improvement of the art itself, or for securing the safety of passengers. He devised simpler, cheaper, and safer forms of apparatus than those in general use. He investigated the influence of legal enactments for regulating steam navigation, and pointed out to legislatures and governments the inefficacy or inexpediency of such enactments, and suggested the true measures to be taken to promote the convenience and secure the safety of the public. He addressed a series of letters through the public prints to one of our prominent naval commanders, setting forth the adaptedness of steam as an agent of national defense. He responded to the call of the Secretary of the United States Treasury to point out the causes of steamboat explosions

and to suggest the means of safety. Happy would it be, if in all the great operations of the mechanical arts, the true spirit of the philosopher were so fully conjoined with the practical knowledge and skill of the engineer. How rapid would be the improvement of the art! How science and art would walk hand in hand, and mutually aid and illustrate each other!

We turn now to another subject which engaged the attention of Mr. Redfield, and brought into exercise his remarkable sagacity and forecast. He was the first to place before the American people the plan of a system of railroads connecting the waters of the Hudson with those of the Mississippi. His pamphlet containing this project, issued in 1829, is a proud monument of his enlarged views, of his accurate knowledge of the topography of the vast country lying between these great rivers, of his extraordinary forecast, anticipating as he did the rapid settlement of the western states, the magic development of their agricultural and mineral wealth, and the consequent rapid growth of our great commercial metropolis. The route proposed is substantially that of the New York and Erie railroad so far as this goes; but his views extended still further, and he marked out, with prophetic accuracy, the course of the railroads which would connect with the Atlantic states, the then infant states of Michigan, Indiana, and Illinois. These, he foresaw, would advance with incredible rapidity the settlement of those regions of unbounded fertility, and would divert no small portion of the trade from the Mississippi to the great metropolis of the east.

It must be borne in mind that railroads for general transportation were unknown in this country until 1826, when the project of constructing the Albany and Schenectady railroad was first entertained. As yet the advantages of railroads had not with us been practically demonstrated, and especially their advantages over canals were not generally understood or appreciated. At the moment when the Erie canal, having just been completed, was at the summit of its popularity, Mr. Redfield set forth in his pamphlet under nineteen distinct heads, the great superiority of railroads to canals, advantages which, although then contemplated only in theory, have been fully established by subsequent experience. He had even anticipated that after the construction of the proposed great trunk railway connecting the Hudson and the Mississippi, many lateral railways and canals would be built, which would bind in one vast net-work the whole great west to the Atlantic

states. "This great plateau (says he) will indeed one day be intersected by thousands of miles of railroad communications; and so rapid will be the increase of its population and resources, that many persons now living will probably see most or all of this accomplished." How well has this remarkable prediction, uttered in 1829, when there was not a foot of railroad in all the country under review, been fulfilled, and how truly has it happened that many of the elder members of this association still live to witness its accomplishment!

The motives which impelled Mr. Redfield to spread this subject before the American people at that early day, when railroads were scarcely known in this country, were purely patriotic. He had no private interests to subserve in the proposed enterprize, and the whole expense of preparing and publishing two editions of the pamphlet embodying these enlarged and prophetic views, was defrayed from his own limited resources.

In 1832, Mr. Redfield, in company with Mr. Morgan, civil engineer, reconnoitered the series of interior valleys through which the Harlem railroad now runs, with a view to the establishment of the New York and Albany railroad. He was instrumental in obtaining the charter of that road, and published a pamphlet entitled "Facts and Suggestions relating to the New York and Albany Railroad." About the same period, in connection with James Brewster, Esq. of New Haven, he explored the route of a railroad leading from New Haven to Hartford, which afterwards resulted in the construction of the Hartford and New Haven railroad. As early as 1829, he addressed a memorial to the Common Council of the City of New York, asking permission to lay an experimental railroad in Canal street. The project of a railroad through one of the public streets of New York was at that time considered as chimerical, but time has developed the wisdom of the plan, and illustrated the sagacity and forecast that first devised it.

When the project of the Hudson River Railroad was started, he entered into it with his characteristic enthusiasm, and was a member of the board of directors, which brought that road to its final completion. In the progress of the work he was deeply interested, frequently visiting all parts of the line, and at different periods examining on foot the entire road between New York and Albany. His associates of the board acknowledged themselves

indebted to him for many valuable suggestions relating to its construction.*

But we turn from these noble enterprises in which the philosopher and the engineer were happily united in the same individual, to the consideration of the great subject which, from this time, formed the leading object of his life, namely, to perfect his *theory of storms.* Nor do we turn away from great practical subjects to such as are merely speculative. The lives and property which Redfield's desinterested labors in behalf of steam navigation contributed to save, would, we believe, be of small amount compared with the sailors and ships which the rules founded on his theory of storms, when fully applied to practice, will save from shipwreck.

We have already seen that the attention of Mr. Redfield was first drawn to the subject of storms in the year 1811, by examining the position of trees prostrated by the great September gale, which passed over Connecticut and the western part of Massachussetts that year. Although he had never lost sight of the theory of storms, yet the multifarious business concerns which engrossed the greater part of his time for a number of years afterwards, prevented his bringing it distinctly before the public until the year 1831. I chanced at that period to meet him for the first time on board a steamboat on the way from New York to New Haven. A stranger accosted me, and modestly asked leave to make a few inquiries respecting some observations I had recently published in the American Journal of Science on the subject of Hailstorms. I was soon made sensible that the humble inquirer was himself a proficient in meteorology. In the course of the conversation, he incidentally brought out his theory of the laws of our Atlantic gales, at the same time stating the leading facts on which his conclusions were founded. This doctrine was quite new to me, but it impressed me so favorably, that I urged him to communicate it to the world through the medium of the American Journal of Science. He manifested much diffidence at

* From the outset Mr. Redfield maintained that the low rate of fares at first adopted would prove inadequate to sustain the road, and published in the papers of that day series of articles to show that the road could not be supported at a less rate than two cents per mile. These views met with much opposition at the time, not only from residents on the line of the road, but from members of the board of directors. But the result has proved the soundness of his judgment on that point.

appearing as an author before the scientific world, professing only to be a practical man little versed in scientific discussions, and unaccustomed to write for the press. At length, however, he said he would commit his thoughts to paper, and send them to me, on condition that I would revise the manuscript and superintend the press. Accordingly, I soon received the first of a long series of articles on the laws of storms, and hastened to procure its insertion in the Journal of Science. Some few of the statements made in this earliest development of his theory, he afterwards found reason for modifying; but the great features of that theory appear there in bold relief. Three years afterwards he published, in the 25th volume of the same journal, an elaborate article on the hurricanes of the West Indies, in the course of which he gives a full synopsis of the leading points of his doctrine as matured by a more extended analysis of the phenomena of storms than he had made when he published his first essay.

Possibly some of those whom I have the pleasure to address, may not have fully acquainted themselves with Redfield's theory of storms, and would desire to be informed of its leading principles. I understand this theory to be substantially as follows:

That all violent gales or hurricanes are great *whirlwinds*, in which the wind blows in circuits around an axis either vertical or inclined; that the winds do not move in horizontal circles, as the usual form of his diagrams would seem to indicate, but rather in spirals towards the axis, a descending spiral movement externally and ascending internally.

That the *direction of revolution* is always uniform, being from right to left, or against the sun, on the north side of the equator, and from left to right, or with the sun, on the south side.

That the *velocity of rotation* increases from the margin towards the center of the storm.

That the whole body of air subjected to this spiral rotation is, at the same time, *moving forward* in a path, at a variable rate, but always with a velocity much less than its velocity of rotation, being at the minimum, hitherto observed, as low as four miles, and at the maximum forty-three miles, but more commonly about thirty miles per hour, while the motion of rotation may be not less than from one hundred to three hundred miles per hour.

That in storms of a particular region, as the gales of the Atlantic, or the typhoons of the China seas, *great uniformity exists in regard to the path pursued*, those of the Atlantic, for example

usually issuing from the equatorial regions eastward of the West India islands, pursuing, at first, a course towards the northwest as far as the latitude of 30°, and then gradually wheeling to the northeast and following a path nearly parallel to the American coast, to the east of Newfoundland, until they are lost in mid-ocean, the entire path when delineated resembling a parabolic curve whose apex is near the latitude of 30°.

That their *dimensions* are sometimes very great, being not less than 1000 miles in diameter, while their path over the ocean can sometimes be traced for 3000 miles.

That the *barometer*, at any given place, falls with increasing rapidity as the centre of the whirlwind approaches, but rises at a corresponding rate after the center has passed by; and finally,

That the phenomena are more uniform in large than in small storms, and more uniform on the ocean than on the land.

These laws Mr. Redfield claims as so many facts independently of all hypothesis; as facts deduced from the most rigorous induction, which will ever hold true, whatever views may be entertained respecting the origin or causes of storms.

The *method* adopted by the author of this theory, in all his inquiries,—the method which first led him to the discovery of the whirlwind character of storms, and afterwards fully confirmed the doctrine,—was first to collect and then to collate as many records as possible of vessels that had been caught in the storm, in various parts of the ocean. The most laborious and profound investigation of this nature of which he has left us an example, is in the case of the Cuba hurricane of October, 1844. First, he examined all accessible marine reports of vessels that had arrived in port after encountering the storm; secondly, he inspected the log-books of all such vessels, as far as was practicable, and carefully transcribed their records; and, thirdly, by an extended correspondence, he obtained a great number of written statements from shipmasters, who of all men would be the most accurate and vigi lant observers. The different independent accounts obtained from these various sources amounted to no less than one hundred and sixty-four, all of which were reduced to the form of tables, containing the latitude and longitude of each vessel or place at the time of observation; the exact date and duration of the gale; the successive directions of the stormwind: the state of the barometer; and, finally, every additional particular that was deemed of the least importance in determining the peculiar characteristics

of the storm. With these data before him, he spread out a marine chart, and having noted on it the position of each vessel and place with the direction and force of the wind the plot itself proclaimed to the eye the whirlwind character of the storm: and the comparison of dates, and corresponding courses of the winds, and respective states of the barometer, showed the dimensions of the storm, its rotary and progressive velocities, its duration at any given place, and its various degrees of violence at different distances from the center. In the character of the researches before us, conducted as they were, not in the shades of philosophic retirement and learned leisure, but in hours redeemed from the pressing avocations of an onerous and responsible business, or borrowed from the season allotted to sleep, we trace qualities of mind that belong only to the true philosopher.

The benevolent and practical mind of Redfield had no sooner established the laws of storms, that it commenced the inquiry, what rules may be derived from it, to promote the safety of the immense amount of human life and of property that are afloat on the ocean, and exposed continually to the dangers of shipwreck; in this, imitating our Franklin, who as soon as he had discovered the identity of lightning with the electricity of our machines, hastened to the inquiry. How may we so apply our knowledge of the laws of electricity as to disarm the thunderbolt of its terrors? We might pursue the comparison and say, that as every building saved from the ravages of lightning by the conducting rod, is a token both of the sagacity and the benevolence of Franklin, so every vessel saved from the horrors of shipwreck by rules derived from these laws of storms, is a witness to the sagacity and benevolence of Redfield. Other writers on the laws of storms, especially Reid and Piddington, have lent important aid in establishing rules for navigators, until it is now easy for the mariner by the direction in which the gale strikes his ship to determine his position in the storm, and the course he must steer in order to escape from its fury. Nor are testimonies wanting of the successful applicating of these rules. The most accomplished navigators (we might instance particularly Commodores Rodgers and Perry, and Commander Glynn, of the U. S. Navy) have testified that within their own observation, many ships have owed their deliverance from the perils of shipwreck to a faithful observance of the rules derived from Redfield's theory of storms. In no department, perhaps, of the studies of nature have mankind been more

surprised to find things governed by fixed laws, than in the case of the winds. It is now rendered in the highest degree probable, that every breeze is a part of some great system of aerial circulation and helps to fulfil some grand design. "Inconstant as the winds" has long been a favorite expression to denote the absence of all uniformity or approach to fixed rules; but the researches of the meteorologists of our times, force on us the conclusion that the winds, even in the violent forms of hurricanes and tornadoes, are governed by laws hardly less determinate than those which control the movements of the planets.

It has been often noticed in the history of science and the arts, that great discoveries and inventions spring forth simultaneously from different independent sources. Thus the discovery of oxygen gas, the greatest single discovery in chemistry, was made almost at the same moment by Priestley in England and Scheele in Sweden; and the method of fluxions, or the infinitesimal calculus, was invented at nearly the same time by Newton and Leibnitz. Such discoveries and inventions are the true resultant of innumerable forces, which at that moment, and never until then since the origin of time, all conspired. It is remarkable that the idea that great storms are progressive whirlwinds, was, for the first time, embraced nearly at the same instant by Redfield and Dové, although the conclusion was arrived at by totally different methods of investigation. Mr. Redfield says in a note to his paper on the Cuba hurricane, published in 1846, that it was not until seven years after the publication of his theory of the rotary and progressive character of storms, that he became acquainted with the suggestions and opinions of Col. Capper, and with the particular views and elucidations published by Professor Dové in his paper on Barometric Minima found in Poggendorff's Annalen for 1828. To all who were personally acquainted with Redfield, it would be quite unnecessary to adduce any other evidence than his simple declaration, of the perfectly original and independent character of his theory of the laws of storms. But we might refer to the circumstances under which it was conceived, when he was far removed from all libraries, and all intercourse with the scientific world; and as respects Dové, in particular, whose essay was communicated to the public in 1828, it may be said, that at that period there was scarcely a copy of Poggendorff's Annalen, in which Dové's essay appeared, in the United States; and being in the German language, nothing could be more im-

probable than that its contents were then known to Redfield. In 1838, our friend found to his great joy a most able ally in Col. Reid of the Royal English Engineers, then stationed in the island of Barbadoes. The earliest inquiries of Col. Reid were based on a violent hurricane, which occurred in that island in the year 1831. Searching for accounts of previous storms, he met with nothing satisfactory until he fell in with Redfield's earliest paper respecting the September gale of 1821, published in the American Journal of Science. With the view of testing Redfield's doctrines, he submitted to the closest scrutiny the records which the Barbadoes storm had left of its ravages,—an investigation which ended in a perfect conviction that this storm was a progressive whirlwind. A friendly correspondence was shortly afterwards opened between these two congenial spirits, which resulted in an intimacy unbroken except by the hand of death. Commodore Perry, in the recent Report of his Japan Expedition, thus expresses himself in an introductory note to Mr. Redfield's Essay (the latest of his published works) on the Cyclones of the Pacific, addressed to Commodore Perry, and forming a part of his volume. "It was my good fortune (says the Commodore) to enjoy, for many years, the friendly acquaintance of one as remarkable for modesty and unassuming pretensions, as for laborious observation and inquiry after knowledge. To him and to Gen. Reid of the Royal Engineers of England (now governor of Malta) are navigators mainly indebted for the discovery of a law which has already contributed and will continue to contribute, greatly to the safety of vessels traversing the ocean. It is true that subsequent writers have furnished additional information on this subject; but to Redfield and Reid should be ascribed, the credit of the original discovery of this undeniable law of nature and its application to useful purposes; and there can be nothing more beautiful, as illustrative of the character of these two men, than the fact, well known to myself; that notwithstanding their simultaneous observations and discoveries, in different parts of the world, neither claimed the slightest merit over the other, but each strove to give to his co-worker in research the meed of superior success in the great object of their joint labors; and thus, without ever meeting, a strong friendship was formed between them, growing out of congenial aspirations for an honorable fame, and mutual admiration of the generous and enlightened views exhibited by each other; and this ennobling feeling was kept alive to the last by friendly correspondence."

The idea of whirlwinds is indeed much older than Redfield or Reid, being as old as the writings of the Psalmist and the Prophets; and we safely admit further, that the doctrine of ocean gales being sometimes of a rotary character, had been hinted at by several writers, as hints of such a principle as gravitation had long preceded the investigations of Newton; but the honor of having established, on satisfactory evidence, the rotary and progressive character of ocean storms, and determining their modes of action or laws, it is due alike to the memory of the departed, and to our country's fame, to claim for WILLIAM C. REDFIELD.

Back of the laws that govern these ocean gales, as first determined by Redfield and confirmed by Dové, Reid, Piddington, Thom, and other well known writers, lies a more profound inquiry, How are these laws themselves to be accounted for? What sets the storm in motion, and gives it the whirlwind character, and at the same time carries it forward, and in so definite a path? What makes it revolve always from right to left on the north side of the equator, and from left to right on the south side? Why does its violence increase towards the centre of the storm, and why is its force there so tremendous? Laws, it must be remembered are facts, and merely express the modes in which nature acts: they are themselves phenomena to be accounted for. To which of the ultimate causes of physical phenomena is their origin, in the present case, to be traced? Is it heat? Is it electricity? Is it gravity? Is it connected in some way with the grand system of planetary motion? Questions of this kind were pressed on Mr. Redfield from various sources by those who assailed his theory. At first he declined any attempts at their solution. He claimed that the whirlwind character of storms, and the laws which he had assigned to them, are matters of fact, as established not only by himself, but also by Reid, Milne, Dové, and Piddington; that never having attempted to establish a theory of winds, nor the origin or first cause of storms, he had no occasion to go into these inquiries, but had long held the proper inquiry to be, *What are storms?* not *How are storms produced?* He however incidentally, at different times, indicated his opinions on the ultimate causes of storms. Electricity, Redfield entirely rejected as an agent in the production of winds and storms, considering its presence and development rather as a consequence than as a cause of atmospheric changes. To heat he assigned only a limited and local effect, denying its agency in producing either the great and

established movements of the atmosphere, or the extraordinary commotions which constituted the chief objects of his study, hurricanes and tempests. But he considered what he called the "dynamics of the atmosphere," as connected with and resulting from the diurnal and annual motions of the earth. While, from the first, I have heartily embraced Redfield's doctrine that ocean gales are progressive whirlwinds, and have further fully believed that he had established their laws or modes of action on an impregnable basis, a regard to truth and candour obliges me to say, that I have never been a convert to his views respecting the ultimate causes of storms, especially so far as he assigned for these causes what he denominates the "diurnal and orbitual motions of the earth," but his notions on this point have always appeared to me unsatisfactory. Nor, while I have been impressed with the belief that *heat* is, in general, by far the most influential of all natural agents in destroying the equilibrium of the atmosphere, and of causing its motions, both in established currents, as the trade winds and the monsoons, and in its violent commotions, as in hurricanes and tornadoes, yet I am compelled to think that but little progress has yet been made in determining its *modus operandi*, or in tracing the *connection* between changes of temperature and the actual phenomena of winds and storms:—why, for example, the Atlantic gales originate where they do, in the tropical regions—why they first pursue a path to the northwest as far as the latitude of 30°, and then gracefully wheel in parabolic curves towards the northeast, and pursue this course for the remainder of their way—why they revolve on their axes and always in one direction—whence they acquire so tremendous a force, especially towards the central parts—why the barometer is so low in the center and so high on the margin of the storm. These and various other points connected with the whirlwind character of storms, seem to me to have met hitherto with but a partial and doubtful solution. The laws constitute the true theory of storms: the rest is yet hypothesis.

Various writers have severally displayed great ingenuity and profound knowledge of atmospheric phenomena, in their endeavours to solve these problems, but with respect to the causes which lie back of the laws of storms, we still remain to a great degree in ignorance. Each of the combatants appears to me to be more successful in showing the insufficiency of the other's views, than in establishing his own. With respect to him who is more par-

ticularly the subject of my remarks, whose logical powers I have always admired, I have almost regretted that he did not adhere to the ground he originally took, namely, that he had not undertaken to explain the reason *why* the winds blow, but only to show *how* they blow. So far was matter of fact: all beyond was hypothesis. His facts are impregnable: his hypothesis doubtful. The conclusions derived legitimately from these facts constitute the laws of storms; and being, as we believe, like the other laws of nature immutable, the name indissolubly associated with their discovery, acquires a fame alike imperishable. Redfield might therefore have safely stopped where Newton stopped. "Newton (says one of his biographers) stopped short at the last fact which he could discover in the solar system—that all bodies were deflected to all other bodies, according to certain regulations of distance and quantity of matter. When told that he had done nothing in philosophy; that he had discovered no cause; and that, to merit any praise, he must show how this deflection was produced; he said, he knew no more than he had told them; that he saw nothing causing this deflection; and was contented with having described it so exactly, that a good mathematician could now make tables of the planetary motions, as accurate as he pleased, and hoped in a few years to have every purpose of navigation and philosophical curiosity completely answered."

Various other contributions to science of our departed friend must, for want of space, be passed by with hardly a notice. Such are his published meteorological essays*—his reports of meteorological observations, which contain many original hints of much value—his paper on the currents of the Atlantic—and his researches in geology, which occupied much of his attention during the latter years of his life—all of which speak the skilful observer, the judicious philosopher, the lover of science, the lover of his country and of his kind. His meteorological researches, although they engrossed a large share of the hours he could redeem from the urgent claims of business, did not prevent his taking a strong interest in other branches of science. He attentively watched the progress of knowledge in various departments, but Geology had for him special attractions. His powers of observation were early employed, even in his pedestrian tour to Ohio in 1810, in noting facts which appeared to him then to be unaccounted for

* Originally prepared for Blunt's Coast Pilot.

but which the progress of the science has since fully explained. In the meetings of the American Association he was an attentive listener to the geological papers, and frequently took part in the discussions which they called forth, exhibiting a thorough acquaintance with the subjects under consideration. The phenomena of the drift period, as evincive of glacial action in various forms had deeply interested him; and he had collected, and closely studied, the shells of recent species which, in the vicinity of New York are found beneath the deposits of drift. His published geological papers, however, relate chiefly to the sandstones of Connecticut and New Jersey, particularly to their fossils, their ripple-marks, and their rain-drops. His residence in early life was within sight of the extensive quarries of this kind of sandstone, at Portland, Connecticut, and his frequent visits afterwards to that region, afforded him opportunity for close observation. In December, 1836, his son Mr. John H. Redfield, who inherits much of the scientific taste of his father, described† some of the fossil fishes from this locality, and shewed that their structural affinities indicated for the so called "New Red Sandstone" a higher position than had previously been assigned to it. Redfield pursued the track thus opened by his son, and published, in the American Journal of Science, descriptions of several new species of Ichthyolites. The last paper which he read before the American Association was upon the Geological Age of the Sandstones of Connecticut and New Jersey, and the contemporaneous deposits in Virginia and North Carolina, He proposed for them the denomination of the *Newark Group*, and showed that the Ichthyolites contained in them pointed unerringly to the Jurassic period. In the course of these investigations he had given close study to the subject of Fossil Fishes, and had formed a collection of them, probably unequalled in this country, with special reference to a contemplated monograph of the Ichthyolites of the Newark Group.

In 1839, Yale College conferred on Mr. Redfield the honorary degree of Master of Arts, and the enlarged sphere in which his labors for the promotion of science and the good of his fellow men, were known and appreciated, was evinced by his election into many learned societies in his own and foreign countries.

Three distinguishing marks of the true philosopher met in William C. Redfield—originality to devise new things; patience to

† Annals Lyc. Nat. History, New York, vol. iv.

investigate; and logical powers to draw the proper conclusions. The impress of his originality he left, in early life, upon the village were he resided; he afterwards imprinted it still deeper on his professional business, as naval engineer; and most of all on his scientific labors, his observations, and his theories. "Patient thought" was the motto of Newton, and in this attribute, Redfield was eminently distinguished. In collecting facts bearing upon his main purpose, and in submitting them to severe and long continued comparison, he has illustrated this quality in its highest forms, as his laborious investigations of the phenomena of hundreds of storms, most fully evince. Originality to invent without patience to investigate, leads to hasty and wild speculations; but united they lay the deep foundations for a severe logic. His powers of reasoning have always appeared to me to be of high order, and he has been fitly characterized by another eminent writer* on the laws of storms, as the "clear-headed" Redfield. Opinions which he had thus formed, after an extensive and patient investigation of the facts, and a severe process of reasoning, he held with great tenacity. But though firm, he was not obstinate. *Obstinacy* we define to be an unyielding adherence to our opinions because we have adopted them: *firmness*, a similar adherence to our opinions, because we believe them to be right.

Few men have given more signal proof of an original inherent love of knowledge Whether we contemplate the apprentice-boy after the toils of the day, seeking for knowledge by the dim light of an open fire: or the father of a young family, through dark scenes of domestic affliction and mournful bereavements, still adding largely year by year to his intellectual stores; or the man of business in the whirl of the great metropolis, loaded with onerous and responsible cares, giving every interval of leisure, and the seasons chiefly employed in pleasure or repose to the study of the laws of nature; or if permitted, as has been my privilege, to be a guest at the house fitted up to be the retreat of his old age, we see the library, the collections of natural history, the many sources of high mental enjoyment, which in the period gained at last of ease and affluence, distinguish the different apartments of his dwelling; or finally whether we call to mind the ever increasing interest with which he attended the meetings of the American Association for the Advancement of Science, and the de-

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* Reid.

light which he experienced in the society of learned men, we observe in all, a mind in love with truth, ever searching and ever expending. In society he was courteous, sincere, upright, and benevolent; in his family, tender, affectionate, wise in counsel and pure in example; in all his walk and conversation, and especially in the church of God, a devout and humble christian.

As the evening of life was passing thus serenely, it hastened to a peaceful close. Mr. Redfield's health had been generally good during his later years, and had seemed particularly so in the early part of the winter which proved his last. On the first of January, he made his usual calls on his friends, and the cheerfulness and vivacity of his manners and healthful expression, were never more remarkable. Near the last of January he was seized with alarming symptoms, which indicated effusion in the chest. His disease made rapid and sure progress. The last book which had engaged his attention previous to his illness was Dr. Kane's recent Narrative of his Arctic Expedition, and his own feverish dreams, during the earlier nights of his sickness, were confusedly identified with the toils, the difficulties, and the sufferings of that heroic commander and his brave companions. With a general tendency to delirium were mingled intervals of calmness, and throughout his illness his countenance would light up with the smile of affection, as he recognized the relations and friends around him. From the first he entertained but slight hopes of recovery; but as the crisis drew near, his mind was at peace, and in calm resignation to the will of his Maker, and in the full exercise of christian faith, he gently breathed his last on the morning of February 12, 1857.

Happy if we who have so long journeyed with him in the delightful walks of science, may enjoy an evening as serene, and find its close as peaceful.

ARTICLE XXXVIII.—*On the Star-Nosed Mole of America.*

Genus, CONDYLURA. (Illiger.)

DENTAL FORMULA.

Incisive $\frac{2}{4}$; *Canine* $\frac{1}{1}$-$\frac{1}{1}$; *Molar* $\frac{8}{7}$–$\frac{8}{7}$=40.

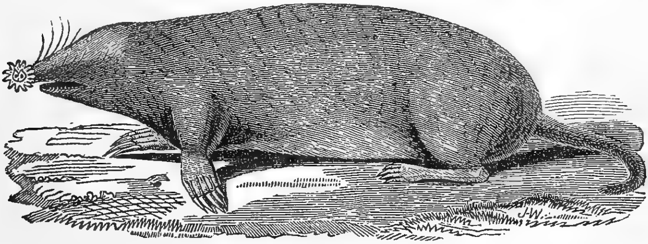
Generic Characters:—Body thick, furry; muzzle much elongated, bordered with membranous crests, disposed star-like round the opening of the nostrils; no ears; eyes small; feet five-toed,

nails formed for digging; those behind slender and weak. The generic name is from the Greek (*kondule*) a swelling, and (*oura*) a tail, in allusion to the swollen state of the tail of this animal sometimes observed. Only one species of this remarkable genus is known, which is the following:—

CONDYLURA CRISTATA. (Linn.)

Synonymes.

SONERE CRISTATA, Linn, Ed. 12, p. 73.
TALPA LONGICAUDATA. Pennant's Hist. Quad., Vol 2, p. 232.
CONDYLURA LONGICAUDATA. Richardson, Fauna, p. 13.
C———— MACROURA. " id. p. 234.
C———— CRISTATA. Audubon & Bachman, Vol. 2, p. 139.



The length of the star-nosed mole from the point of the nose to the root of the tail is about 5 inches, length of tail three inches, from heel to end of claw $\frac{7}{8}$ of an inch, breadth of palm $\frac{6}{8}$. The head is long pointed and terminated in a snout which, at its extremity is surrounded by a fringe of about twenty cartilaginous points. The body is cylindrical, the neck short, and the eyes small. The moustaches are few and short. There is an orifice in place of an external ear, which does not project through the skin. The fore feet are longer than those of the common American shrew mole, the palms destitute of hairs, but covered with scales; claws, flattened, sharp, channelled beneath; hind extremities longer than the fore ones, placed far back; feet nearly naked, scaly; tail sub-cylindrical, sparingly covered with coarse hair. The fur is brownish black; some of the specimens have dark brown feet, others pale ashy brown or even white.

This animal is a harmless little creature, subsisting on insects, worms and larvæ of various kinds. According to Dr. Godman it prefers the banks of small streams or swampy land, where in many places the burrows are so numerous that "it is scarcely possible

to advance a step without breaking down their galleries. The excavations which are most continuous, and appear to be most frequented, are placed at a short distance below the roots of the grass on the banks of small streams; these are to be traced along their margins, following every inflexion, and making frequent circuits in order to pass large stones or roots of trees, to regain their usual proximity to the surface nearest the water." Audubon says that the burrows are deeper than those described by Godman, and that the chamber of habitation at the end is spacious, with a comfortable nest of withered leaves and dry grass. Out of one of these he took three young ones about a week old, and found that the radiations of the nose were then so slightly developed that the animals might have been mistaken for the young of the common mole. When confined in a box they would eat meat.

The nse of the extraordinary appendage at the end of the nose is not known wlth certainty. It is only barely probable that as the animal subsists by groping about under the ground in search of worms and other small prey, the ornament on his muzzle may assist it in the search.

At certain seasons it is observed that the tail of the star-nosed mole is much swollen, and hence the mistake of Dr. Harlow, who, upon a specimen taken in this condition, made a new species with the name *macroura*, or long tailed mole. This species is found in Canada but rarely, although it appears to be distributed all over the province. In the United States it occurs in all the northern and eastern portions and as far south as the borders of South Carolina.

ARTICLE XXXIX.—*On the Mink*, (*Putorius vison.*)

Genus PUTORIUS.—(Cuvier.)

DENTAL FORMULA.

Incisive, $\frac{6}{6}$; *Canine*, $\frac{1}{1}$—$\frac{1}{1}$; *Molar*, $\frac{4}{5}$—$\frac{4}{5}$ = 34.

Generic Characters.—There are two false molars above, and three below; the great carnivorous tooth below, without an internal tubercle; the tuberculous tooth in the upper jaw, very long.

Head, small and oval; muzzle, short and blunt; ears, short and round; body, long and vermiform; neck, long; legs, short; five toes on each foot, armed with sharp crooked claws; tail,

long and cylindrical. Animals of this genius emit a fetid odour, and are nocturnal in habit; they are separated from the martens in consequence of having one tooth less on each side of the upper jaw; their muzzle is also shorter and thicker than that of the marten. The species are generally small in size, and seldom climb trees like the true martens.

There are about fifteen well determined species of this genus, six of which belong to America, and the remainder to the Eastern continent.

The generic name *putorious* is derived from the Latin word *putor*—a fetid smell.—*Audubon & Bachman, Quadrupeds of America,* vol. 1, p. 250.

PUTORIUS VISON.—Linn.

THE MINK.

The fur of this animal has of late years become so highly esteemed as an article of comfortable dress during the severe cold of our long winters, that perhaps few of our lady readers could believe herself prepared for a drive without clothing herself to a greater or less extent in the rich and warm jacket once the exclusive property and protection of Mr. Putorius vison. The usual color of the Mink is an uniform brown or tawny, with light brownish or yellow fur beneath, next the body. Some of the specimens are much darker than others. There is a white spot under the throat and another on the breast; the lower jaw is also white. The length of the head and body is about 13 inches, and of the tail 7 inches. The body is long and slender, the head small and flattish, neck long, legs short, and feet partly webbed. The geographical distribution of the species appears to be co-extensive with the North American Continent. It is known in all parts of Canada and the United States, and Sir John Richardson met with it as far north as latitude 66°. The word Mink is a corruption of the Swedish Moenk, a name given to a closely allied species in Sweden. In fact the *Mustela lutreola* of Northern Europe is still believed by many naturalists to be the same as the American *P. vison.* It affords one of the many proofs of the close relationship that exists between the northern faunæ of the two continents. Thus the moose deer can scarcely be distinguished from the Scandinavian elk, the caribou of the barren grounds (*Tarandus arcticus*) from the reindeer of Lapland; the pine marten of Canada is also found in Europe; the musk ox

formerly inhabited Britain; and the American beaver is identical with the European species. Between the southern extremities of the old and new worlds no such affinities exist. We believe the fauna of South America is totally different from that of Africa.

This animal is an expert hunter, and although of an aquatic habit, subsists much upon birds, mice, and other small animals. Audubon gives the following account of its exploits :—

"There is a small brook, fed by several springs of pure water, which we have caused to be stopped by a stone dam to make a pond for ducks in the summer and ice in the winter; above the pond is a rough bank of stones through which the water filters into the pond. There is a little space near this where the sand and gravel have formed a diminutive beach. The ducks descending to the water are compelled to pass near this stony bank. Here a Mink had fixed his quarters with certainly a degree of judgment and audacity worthy of high praise, for no settlement could promise to be more to his mind. At early dawn the crowing of several fine cocks, the cackling of many hens and chickens, and the paddling, splashing, and quacking of a hundred old and young ducks would please his ears ; and by stealing to the edge of the bank of stones, with his body nearly concealed between two large pieces of broken granite, he could look around and see the unsuspecting ducks within a yard or two of his lurking place. When thus on the look out, dodging his head backward and forward he waits until one of them has approached close to him, and then with a rush seizes the bird by the neck, and in a moment disappears with it between the rocks. He has not, however, escaped unobserved, and like other rogues deserves to be punished for having taken what did not belong to him. We draw near the spot, gun in hand, and after waiting some time in vain for the appearance of the Mink, we cause some young ducks to be gently driven down to the pond—diving for worms or food of various kinds while danger so imminent is near them—intent only on the objects they are pursuing, they turn not a glance toward the dark crevice where we can now see the bright eyes of the Mink as he lies concealed. The unsuspecting bird remind us of some of the young folks in that large pond we call the world, where, alas! they may be in greater danger than our poor ducks or chickens. Now we see a fine hen descend to the water ; cautiously she steps on the sandy margin and dipping her bill in the clear stream, sips a few drops and raises her head as if in gratitude

to the Giver of all good; she continues sipping and advancing gradually; she has now approached the fatal rocks, when with a sudden rush the Mink has seized her; ere he can regain his hole however, our gun's sharp crack is heard and the marauder lies before us."

"We acknowledge that we have little inclination to say anything in defence of the Mink. We must admit, however, that although he is a cunning and destructive rogue, his next door neighbour, the ermine or common weasel, goes infinitely beyond him in his mischievous propensities. Whilst the Mink is satisfied with destroying one or two fowls at a time, on which he makes a hearty meal; the weasel, in the very spirit of wanton destructiveness, sometimes in a single night puts to death every tenant of the poultry-house!"

"Whilst residing at Henderson, on the banks of the Ohio river, we observed that Minks were quite abundant, and often saw them carrying rats which they caught like the weasel or ferret, and conveyed away in their mouths, holding them by the neck in the manner of a cat."

"Along the trout streams of our Eastern and Northern States the Mink has been known to steal fish that having been caught by some angler, had been left tied together with a string while the fisherman proceeded farther in quest of more. An angler informed us that he had lost in this way thirty or forty fine trout, which a Mink dragged off the bank into the stream and devoured, and we have been told that by looking carefully after them, the Mink could be seen watching the fisherman and in readiness to take his fish, should he leave it at any distance behind him. Mr. Hutson of Halifax informed us that he had a salmon weighing four pounds carried off by one of them."

"We have observed that the Mink is a tolerably expert fisher. On one occasion, whilst seated near a trout-brook in the northern part of the State of New York, we heard a sudden splashing in the stream and saw a large trout gliding through the shallow water and making for some long overhanging roots on the side of the bank. A Mink was in close pursuit, and dived after it; in a moment afterwards it re-appeared with the fish in its mouth. By a sudden rush we induced it to drop the trout, which was upwards of a foot in length."

"We are disposed to believe, however, that fishes are not the principal food on which the Mink subsists. We have sometimes

seen it feeding on frogs and cray-fish. In the Northern States we have often observed it with a Wilson's meadow-mouse in its mouth, and in Carolina the very common cotton-rat furnishes no small proportion of its food. We have frequently remarked it coursing along the edge of the marshes, and found that it was in search of this rat, which frequents such localities, and we discovered that it was not an unsuccessful mouser. We once saw a Mink issuing from a hole in the earth, dragging by the neck a large Florida rat."

"This species has a good nose, and is able to pursue its prey like a hound following a deer. A friend of ours informed us that once while standing on the border of a swamp near the Ashley river, he perceived a marsh-hare dashing by him; a moment after came a Mink with its nose near the ground, following the frightened animal, apparently by the scent, through the marsh.

"In the vicinity of Charleston, South Carolina, a hen-house was one season robbed several nights in succession, the owner counting a chicken less every morning. No idea could be formed, however, of the manner in which it was carried off. The building was erected on posts, and was securely locked, in addition to which precaution a very vigilant watch-dog was now put on guard, being chained underneath the chicken-house. Still, the number of fowls in it diminished nightly, and one was as before missed every morning.

"We were at last requested to endeavour to ascertain the cause of the vexatious and singular abstraction of our friend's chickens, and on a careful examination we discovered a small hole in a corner of the building, leading to a cavity between the weather-boarding and the sill. On gently forcing outward a plank, we perceived the bright eyes of a Mink peering at us and shining like a pair of diamonds. He had long been thus snugly ensconced, and was enabled to supply himself with a regular feast without leaving the house, as the hole opened toward the inside on the floor. Summary justice was inflicted of course on the concealed robber, and peace and security once more were restored in the precincts of the chicken yard.

"This species is very numerous in the salt-marshes of the Southern States, where it subsists principally on the marsh-hen, (*Rallus crepitans*,) the sea-side finch, (*Ammodramus maritimus*,) and the sharp-tailed finch, (*A. caudacutus*,) which, during a considerable portion of the year, feed on the minute shell-fish and aquatic in-

sects left on the mud and oyster-banks, on the subsiding of the waters. We have seen a Mink winding stealthily through the tall marsh-grass, pausing occasionally to take an observation, and sometimes lying for the space of a minute flat upon the mud: at length it draws its hind-feet far forwards under its body in the manner of a cat, its back is arched, its tail curled, and it makes a sudden spring. The screams of a captured marsh-hen succeed, and its upraised fluttering wing gives sufficient evidence that it is about to be transferred from its pleasant haunts in the marshes to the capacious maw of the hungry Mink.

"It is at low tide that this animal usually captures the marsh-hen. We have often at high spring tide observed a dozen of those birds standing on a small field of floating sticks and matted grasses, gazing stupidly at a mink seated not five feet from them. No attempt was made by the latter to capture the birds that were now within his reach. At first we supposed that he might have already been satiated with food and was disposed to leave the tempting marsh hens till his appetite called for more; but we were after more mature reflection inclined to think that the high spring tides which occur, exposing the whole marsh to view and leaving no place of concealment, frighten the Mink as well as the marsh-hen; and as misery sometimes makes us familiar with strange associates, so the Mink and the marsh-hen like neighbour and brother hold on to their little floating islands till the waters subside, when each again follows the instincts of nature. An instance of a similar effect of fear on other animals was related to us by an old resident of Carolina: some forty years ago, during a tremendous flood in the Santee river, he saw two or three deer on a small mound not twenty feet in diameter, surrounded by a wide sea of waters, with a cougar seated in the midst of them; both parties, having seemingly entered into a truce at a time when their lives seemed equally in jeopardy, were apparently disposed peaceably to await the falling of the waters that surrounded them.

"The Minks which resort to the Southern marshes, being there furnished with an abundant supply of food are always fat, and appear to us considerably larger than the same species in those localities where food is less abundant.

"This species prefers taking up its residence on the borders of ponds and along the banks of small streams, rather than along large and broad rivers. It delights in frequenting the foot of

rapids and waterfalls. When pursued it flies for shelter to the water, an element suited to its amphibious habits, or to some retreat beneath the banks of the stream. It runs tolerably well on high ground and we have found it on several occasions no easy matter to overtake it, and when overtaken, we have learned to our cost that it was rather a troublesome customer about our feet and legs, where its sharp canine teeth made some uncomfortable indentations; neither was its odour as pleasant as we could have desired. It is generally supposed that the Mink never resorts to a tree to avoid pursuit; we have, however, witnessed one instance to the contrary. In hunting for the ruffed-grouse, (*T. Umbellus*,) we observed a little dog that accompanied us, barking at the stem of a young tree, and on looking up, perceived a Mink seated in the first fork, about twelve feet from the ground. Our friend, the late Dr. Wright, of Troy, informed us that whilst he was walking on the border of a wood, near a stream, a small animal which he supposed to be a black squirrel, rushed from a tuft of grass, and ascended a tree. After gaining a seat on a projecting branch, it peeped down at the intruder on its haunts, when he shot it, and picking it up, ascertained that it was a Mink.

"We think, however, that this animal is not often seen to ascend a tree, and these are the only instances of its doing so which are known to us.

"This species is a good swimmer, and like the musk-rat dives at the flash of a gun; we have observed, however, that the percussion-cap now in general use is too quick for its motions, and that this invention bids fair greatly to lessen its numbers. When shot in the water the body of the Mink, as well as that of the otter, has so little buoyancy, and its bones are so heavy, that it almost invariably sinks.

"The Mink, like the musk-rat and ermine, does not possess much cunning, and is easily captured in any kind of trap; it is taken in steel-traps and box-traps, but more generally in what are called dead-falls. It is attracted by any kind of flesh, but we have usually seen the traps baited with the head of a ruffed grouse, wild duck, chicken, jay, or other bird. The Mink is exceedingly tenacious of life, and we have found it still alive under a dead-fall, with a pole lying across its body pressed down by a weight of 150 lbs., beneath which it had been struggling for nearly twenty-four hours.

"This species, as well as the skunk and the ermine, emits an

offensive odour when provoked by men or dogs, and this habit is exercised likewise in a moderate degree whenever it is engaged in any severe struggle with an animal or bird on which it has seized. We were once attracted by the peculiar and well-known plaintive cry of a hare, in a marsh on the side of one of our Southern rice-fields, and our olfactories were at the same time regaled with the strong fetid odour of the Mink; we found it in possession of a large marsh-hare, with which, from the appearance of the trampled grass and mud, it had been engaged in a fierce struggle for some time.

"The Mink, when taken young, becomes very gentle and forms a strong attachment to those who fondle it in a state of domestication. Richardson saw one in the "possession of a Canadian woman, that passed the day in her pocket, looking out occasionally when its attention was roused by any unusunl noise." We had in our possession a pet of this kind for eighteen months; it regularly made a visit to an adjoining fish-pond both morning and evening, and returned to the house of its own accord, where it continued during the remainder of the day. It waged war against the Norway rats which had their domicile in the dam that formed the fish-pond, and it caught the frogs which had taken possession of its banks. We did not perceive that it captured many fish, and it never attacked the poultry. It was on good terms with the dogs and cats, and molested no one unless its tail or foot was accidentally trod upon, when it invariably revenged itself by snapping at the foot of the offender.

"It was rather dull at mid-day, but very active and playful in the morning and evening and at night. It never emitted its disagreeable odour except when it had received a sudden and severe hurt. It was fond of squatting in the chimney-corner, and formed a particular attachment to an arm-chair in our study.

"The Mink brings forth about five or six young in the latter part of the Spring, but it does not appear that more than one litter is produced in the season."

ARTICLE XL.—*The Common Weasel*, (*Putorius erminea.*)

Putorius erminea.—Linn.

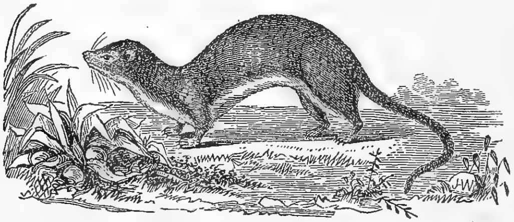
White Weasel.—Stoat.

The common Weasel of Canada is the true Ermine, the animal which in the feudal ages yielded the fur for the most choice

mantles of nobles and kings. The best naturalists, after the most careful examination and comparison of specimens from all the countries inhabited by this species, have failed to detect any difference whatever of sufficient importance to justify the separation of the American from the European or Asiatic Ermine. Its geographical range therefore is enormous, being nearly the whole of the northern part of the world as far south as latitude 40°.

The length of the ermine from the point of the nose to the root of the tail is about ten inches, length of tail five inches and a-half. The color is pure white or yellowish-white in winter, and in summer reddish-brown above and white beneath. The tip of the tail is always black. The body is slender, legs short, five toes on each foot, inner toe the shortest, ears broad and rounded, the fur soft and short, and the tail somewhat bushy at the end.

Audubon describes the Weasel as "fierce and bloodthirsty, possessing an intuitive propensity to destroy every animal and bird



within its reach, some of which, such as the American rabbit, the ruffed grouse, and domestic fowl, are ten times its own size. It is a notorious and hated depredator of the poultry house, and we have known forty well grown fowls to have been killed in one night by a single Ermine. Satiated with the blood of probably a single fowl, the rest, like the flock slaughtered by the wolf in the sheepfold, were destroyed in obedience to a law of nature, an instinctive propensity to kill. We have traced the footsteps of this bloodsucking little animal on the snow, pursuing the trail of the American rabbit, and although it could not overtake its prey by superior speed, yet the timid hare soon took refuge in the hollow of a tree, or in a hole dug by the marmot, or skunk. Thither it was pursued by the Ermine, and destroyed, the skin and other remains at the mouth of the burrow bearing evidence of the fact. We observed an Ermine, after having captured a hare of the above species, first behead it and then drag the body some twenty

yards over the fresh fallen snow, beneath which it was concealed, and the snow tightly pressed over it; the little prowler displaying thereby a habit of which we became aware for the first time on that occasion. To avoid a dog that was in close pursuit it mounted a tree and laid itself flat on a limb about twenty feet from the ground, from which it was finally shot. We have ascertained by successful experiments, repeated more than a hundred times, that the Ermine can be employed, in the manner of the ferret of Europe, in driving our American rabbit from the borrow into which it has retreated. In one instance, the Ermine employed had been captured only a few days before, and its canine teeth were filed in order to prevent its destroying the rabbit; a cord was placed around its neck to secure its return. It pursued the hare through all the windings of its burrow and forced it to the mouth, where it could be taken in a net, or by the hand. In winter, after a snow storm, the ruffed grouse has a habit of plunging into the loose snow, where it remains at times for one or two days. In this passive state the Ermine sometimes detects and destroys it. In an unsuccessful attempt at domesticating this grouse by fastening its feet to a board in the mode adopted with the stool pigeon, and placing it high on a shelf, an Ermine which we had kept as a pet, found its way by the curtains of the window and put an end to our experiment by eating off the head of our grouse."

"Nothwithstanding all these mischievous and destructive habits, it is doubtful whether the Ermine is not rather a benefactor than an enemy to the farmer, ridding his granaries and fields of many depredators on the product of his labour, that would devour ten times the value of the poultry and eggs which, at long and uncertain intervals, it occasionally destroys. A mission appears to have been assigned it by Providence to lessen the rapidly multiplying number of mice of various species and the smaller rodentia."

"The white-footed mouse is destructive to the grains in the wheat fields and in the stacks, as well as the nurseries of fruit trees. LeConte's pine-mouse is injurious to the Irish and sweet potato crops, causing more to rot by nibbling holes into them that it consumes, and Wilson's meadow-mouse lessens our annual product of hay by feeding on the grasses, and by its long and tortuous galleries among their roots.

"Wherever an Ermine has taken up his residence, the mice in its vicinity for half a mile round have been found rapidly to dimi-

nish in number. Their active little enemy is able to force its thin vermiform body into the burrows, it follows them to the end of their galleries, and destroys whole families. We have on several occasions, after a light snow, followed the trail of this weasel through fields and meadows, and witnessed the immense destruction which it occasioned in a s'ngle night. It enters every hole under stumps, logs, stone heaps and fences, and evidence of its bloody deeds are seen in the mutilated remains of the mice scattered on the snow. The little chipping or ground squirrel, *Tamias Lysteri*, takes up its residence in the vicinity of the grain fields, and is known to carry off in its cheek pouches vast quantities of wheat and buckwheat, to serve as winter stores. The Ermine instinctively discovers these snug retreats, and in the space of a few minutes destroys a whole family of these beautiful little *Tamiæ;* without even resting awhile until it has consumed its now abundant food, its appetite craving for more blood, as if impelled by an irresistible destiny, it proceeds in search of other objects on which it may glut its insatiable vampire-like thirst. The Norway rat, and the common house-mouse take possession of our barns, wheat stacks, and granaries, and destroy vast quantities of grain. In some instances the farmer is reluctantly compelled to pay even more than a tithe in contributions towards the support of these pests. Let however an Ermine find its way into these barns and granaries, and there take up its winter residence, and the havoc which is made among the rats and mice will soon be observable. The Ermine pursues them to their farthest retreats, and in a few weeks the premises are entirely free from their depredations. We once placed a half domesticated Ermine in an outhouse infested with rats, shutting up the holes on the outside to prevent their escape. The little animal soon commenced his work of destruction. The squeaking of the rats was heard throughout the day. In the evening, it came out licking its mouth, and seeming like a hound after a long chase, much fatigued. A board of the floor was raised to enable us to ascertain the result of our experiment, and an immense number of rats were observed, which although they had been killed on different parts of the building, had been dragged together, forming a compact heap."

" The Ermine is then of immense benefit to the farmer. We are of the opinion that it has been over-hated and too indiscriminately persecuted. If detected in the poultry house, there is some excuse for destroying it, as, like the dog that has once been caught

in the sheepfold, it may return to commit further depredations; but when it has taken up its residence under stone heaps and fences, in his fields, or his barns, the farmer would consult his interest by suffering it to remain, as by thus inviting it to a home, it will probably destroy more formidable enemies, relieve him from many petty annoyances, and save him many a bnshel of grain."

The Ermine brings forth its young from four to seven at a litter in the months of April and May, and it is said that the family usually remain in the same locality until autumn. With respect to the change of colour, Audubon is of opinion that it is effected by shedding the hair, the new coat coming out in a different color. On the other hand, an European naturalist, Mr. Bell, thinks that the hair changes colour. Upon this subject, and also upon the habits of the species in Britain, we make the following extract from Knight's English Cyclopædia, page 1006 :—

With regard to the mode in which this alteration is brought about, Mr. Bell expresses his belief that the winter change is effected not by the loss of the summer coat and the substitution of a new one, but by the actual change of colour in the existing fur; and he cites, in proof of this view of the subject, the case of the Hudson's Bay Lemming, which in Captain Sir John Ross's first Polar Expedition was exposed in its summer coat on the deck to a temperature of 30° below zero, and the next morning the fur on the cheeks and a patch on each shoulder had become perfectly white. Next day the shoulder-patches had considerably extended, and the posterior part of the body and flanks had turned to a dirty white. At the end of a week the winter change was complete, with the exception of a dark band across the shoulders prolonged down to the middle of the back.

That change of temperature, and not merely change of season is necessary to effect the alteration of colour is evident from Mr. Hogg's observations. (5th vol. of Loudon's 'Magazine of Nat. Hist.;' Bell, 'British Quadrupeds.')

Mr. Hogg, whose remarks appear to have been made in the county of Durham, states that within the last nine years from the date of his communication he had met with two Ermines alive, and in the most different winters that had occurred for many years. One was observed in the extremely severe winter (January to March) of 1823; the other in the extremely mild January of 1832.

"In consequence of the months of December, 1831, and January, 1832, having been so extremely mild, I was," says Mr. Hogg, "greatly surprised to find this stoat clothed in his winter fur; and the more so, because I had seen about three weeks or a month before, a stoat in its summer coat or brown fur. I was therefore naturally led to consider whether the respective situations which the brown and white stoats seen by me this warm winter inhabited, could alone account for the difference of the colour of their fur, in any clear and satisfactory manner. The situation then where the Brown Stoat was seen, is in nearly 54° 32′ N. lat., 1° 19′ W. long., upon a plain elevated a very few feet above the level of the river Tees, in the county of Durham. Again, the place where I met with the Ermine, or White Stoat, on the 23rd of January, 1832, is in the North Riding of Yorkshire, in nearly 54° 12′ N. lat., 1° 13′ W. long.; it is situated at a very considerable elevation, and in the immediate neighbourhood of the lofty moorlands called the Hambledon Hills. These constitute the south-western range of the Cleveland Hills, which rise in height from 1100 feet to 1200 feet above the sea. At the time, the Ermine was making his way towards the hills, where, no doubt, he lived, or frequently haunted; and consequently the great coldness of the atmosphere, even in so mild a winter, upon so elevated and bleak a spot as that moorland, would satisfactorily account for the appearance of the animal in its white fur; although the place is, in a direct line, more than 23 miles distant to the south of the fields near the Tees, inhabited by the Brown Stoat."

The Ermine-Weasel, the length of whose head and body is 9 inches 10 lines, the tail being 4 inches 8 lines, is the Carlwm of the Welsh; Stoat, Stout, and greater Weasel of the English; L'Hermine and Le Roselet of the French; Armellino of the Italians; Armino and Armelina of the Spanish; Hermelin of the Germans; Hermelin and Lekatt of the Swedes; Hermilyn of the Dutch; Hermelin and Lekat of the Danes; Seegoos and Shacooshew of the Cree Indians; and Terreeya of the Esquimaux.

The Ermine is found generally in temperate Europe, but common only in the north. The finest, that is, those with the longest and thickest fur, and of the purest and brightest colour, are imported from the high latitudes. Russia, Norway, Sweden, Siberia, and Lapland, furnish them abundantly. The British importation, in 1833, was 105,139; and 187,000. In America it is found from the most northern limits to the middle districts of the United

States. Ermine-skins formed part of the Canada exports in the time of Charlevoix; but they have so sunk in value, that they are said not to repay the Hudson's Bay Company the expense of collecting them, and very few are brought to this country from that quarter.

"It appears that in England generally," says Mr. McGillivray, "the Ermine is less common than the Weasel; but in Scotland, even to the south of the Frith of Forth, it is certainly of more frequent occurrence than that species; and for one Weasel I have seen at least five or six Ermines. It frequents stoney places and thickets, among which it finds a secure retreat, as its agility enables it to outstrip even a dog in a short race, and the slimness of its body allows it to enter a very small aperture. Patches of furze, in particular, afford it perfect security, and it sometimes takes pessession of a rabbit's burrow. It preys on game and other birds, from the grouse and ptarmigan downwards, sometimes attacks poultry or sucks their eggs, and is a determined enemy to rats and moles. Young rabbits and hares frequently become victims to its rapacity, and even full-grown individuals are sometimes destroyed by it. Although in general it does not appear to hunt by scent, yet it has been seen to trace its prey like a dog, following its track with certainty. Its motions are elegant, and its appearance extremely animated. It moves by leaping or bounding, and is capable of running with great speed, although it seldom trusts itself beyond the immediate vicinity of cover. Under the excitement of pursuit however its courage is surprising, for it will attack, seize by the throat, and cling to a grouse, hare, or other animal, strong enough to carry it off, and it does not hesitate on occasion to betake itself to the water. Sometimes when met with in a thicket or stoney place, it will stand and gaze upon the intruder, as if conscious of security; and, although its boldness has been exaggerated in the popular stories which have made their way into books of natural history, it cannot be denied that, in proportion to its size, it is at least as courageous as the tiger or the lion."

Mr. Bell was informed by the Rev. F. W. Hope that the latter, while shooting in Shropshire, was attracted by the loud shrill scream of a hare which he thought had been just caught in a poacher's snare. He ran towards the spot, and there saw a hare limping off, apparently in great distress, with something attached to the side of the throat. This proved to be a stoat, and the stricken hare made its way into the brushwood with its enemy

still holding on. In England it takes advantage of the galleries of the mole for its winter retreat, as well as the rabbit burrow.

Captain Lyon, R.N., saw the Ermine hunting the footsteps of mice in the North as a hound would hunt a fox, and observed their burrows in the snow, which were pushed up in the same manner as the tracks of moles in Britain. These passages ran in a serpentine direction, and near the hole or dwelling-place the circles were multiplied as if to render the approach more intricate.

The same graphic voyager gives a lively description of a captive Ermine :—" He was a fierce little fellow, and the instant he obtained day light in his new dwelling, he flew at the bars, and shook them with the greatest fury, uttering a very shrill passionate cry, and emitting the strong musky smell which I formerly noticed. No threats or teasing could induce him to retire to the sleeping-place, and whenever he did so of his own accord, the slightest rubbing on the bars was sufficient to bring him out to the attack of his tormentors. He soon took food from the hand, but not until he had first used every exertion to reach and bite the fingers which conveyed it. This boldness gave me great hopes of being able to keep my little captive alive through the winter, but he was killed by an accident."

Sir John Richardson states that the Ermine is a bold animal, and often domesticates itself in the habitations of the fur-traders, where it may be heard the live-long night pursuing the white-footed mouse (*Mus leucopus*). He remarks that, according to Indian report, this species brings forth ten or twelve young at a time. In this conntry it produces about five in April or May.

In Siberia, Ermines are taken in traps baited with flesh ; and in Norway they are either shot with blunt arrows, or taken in traps made of two flat stones, one being propped up with a stick, to which is fastened a baited string. This the animal nibbles, when the stone falls and crushes it. Two logs of wood are used for the same purpose and in the same manner in Lapland.

ARTICLE XLI.—*On the Pine Marten.* (*Mustela martes.*)

MUSTELA MARTES.—(Linn.)

The Marten, also called the Pine Marten, is larger than the mink, and almost always of a lighter colour. The body is slender, the head long and pointed, ears broad and obtusely pointed, legs stout, eyes small and black, and the toes with long, slender and compressed nails concealed by hair; tail bushy and cylindrical. Hair of two kinds, the outer long and rigid, the inner soft and somewhat wooly. The length from point of nose to root of tail is about eighteen inches, length of tail seven inches.

The colour varies a good deal in different individuals, but it is generally yellowish, shaded with more or less black,—the throat is yellow. The Marten is an exceedingly active and destructive little animal,—but as its habits confine it to the depths of the forest, it seldom visits the farm-yard, and consequently is no annoyance to man. Its food consists of birds, mice, squirrels, and other small animals, and its activity is such that it climbs trees with

great facility. The female brings forth six or eight young at a litter, in a burrow under ground, a hollow tree, or in some warm nest constructed in a crevice among the rocks. The species is found in the Northern and Eastern States, throughout Canada, and in all the wooded districts of the Hudsons Bay Company's Territories. It ranges across the continent from the Atlantic to the Pacific, and is supposed to be identical with the species of Northern Europe. Sir John Richardson, the celebrated Northern traveller, in the North West, says that particular districts produce different varieties of this animal, the fur of some of the varieties being of more value than that of others. It is easily caught with traps. "A partridge's head with the feathers is the best bait for the log traps in which it is caught. It does not reject carrion, and often

destroys the hoards of meat and fish laid up by the natives, when they have accidentally left a crevice by which it can enter. When its retreat is cut off it shews its teeth, sets up its hair, arches its back, and hisses like a cat. It will seize a dog by the nose and bites so hard, that unless the latter is well used to the combat it escapes. Easily tamed it soon becomes attached to its master, but is not docile. The flesh is occasionally eaten, but not prized by the Indians. The females are smaller than the males, go with young about six weeks, and produce from four to seven at a time, about the end of April. When caught in traps this species is often devoured by its near relation the Fisher. Pennants marten (*Mustela Canadensis.*)

As an article of commerce and of luxurious and ornamental dress, the fur of this animal is well known. It is said that 100,000 skins are annually taken to Britain. Yet as the species is very prolific, it is still a common animal in the large forests. In the settlements, however, it soon becomes exterminated. The fox lingers around among the agriculturists, and pays his attentions to the farm-yard long after the marten has left the scene of advancing civilization.

ARTICLE XLII.—*Extracts from the Proceedings of the British Association for the Advancement of Science.* Dublin, August 26,—September 2, 1857.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

Professor HENNESSY read a paper on the *Direction of Gravity at the Earth's Surface.* For all practical purposes, he said, the direction of gravity was considered perpendicular to the earth's surface; and a similar assumption was often made in writings claiming a high degree of scientific accuracy. This arose from defining the earth's surface as the surface of equilibrium of the waters. If the earth were stripped of its fluid covering, the irregular surface so laid bare might be intersected by a surface so placed that the volume of all the eminences rising above it would be equal to the volume of all the depressions. With the data at present possessed it would be nearly possible to have the mean surface. They were not in a position to say how far it approached or differed from a surface of equilibrium, or in other words, they could not assume that gravity was rigorously perpendicular to such

a surface. Actual observation showed that in many places it was not so, and this non-perpendicularity was generally referred to irregularities of surface. If, as everything led them to believe, the earth was originally in a state of fusion from heat, all the strata of equal density of the fluid mass would be surfaces of equilibrium. Following out the theory, the paper went on to show that if it could be ascertained what was the form of the outer surface of the earth's solidified crust, and the distribution of the water over it, they might be able to determine whether changes of internal structure took place within the earth subsequent to the formation of that crust. Observations showed that such internal changes had taken place, and consequently that the direction of gravity might have changed.

Major-General SABINE *on the Amount and Frequency of the Magnetic Disturbance and Aurora at Point Barrow, on the Shores of the Polar Sea.* The lecturer stated that his results were derived from observations made by Captain Maguire and the officers of the Plover, between July 1852 and July 1854. Point Barrow is situated on the most northern coast of America. Tables made on a large scale were used, exhibiting the variations with and without the disturbances at different hours of the day at Point Barrow and at Toronto. The horizontal force of the earth at Toronto was about double what it was at Point Barrow. It was found that when the disturbances were greatest in amount, the greatest displays, which he considered a magnetic phenomenon, took place. The last letter he had received from Sir John Franklin expressed that navigator's determination to put up instruments for the observation of those phenomena at the several stations at which he might winter It could not be doubted that such obervations were made and recorded with the instruments they took for that purpose. It could not be doubted that when they were detained at some point the following year they carefully made the observations, and it was possible they might have even extended them to another winter. These observations were numerous, and were of such a kind as would have been left in the ships when the explorers proceeded overland. When he (General Sabine) was with Captain Parry in 1848, they made observations as to the figure of the earth, and various other matters, on their way to Behring's Straits. They were exposed to considerable risk of the ships being lost, and when about to take to the boats and proceed overland, they merely carried with them an abstract of the observations, leaving the full

records deposited in cases in the cabins of the ships. He had no doubt that in the ships of Sir John Franklin his observations were to be fouud; and this was the reason why men of science were so anxious to recover the ships; for, first of all, the journals would contain valuable information, and next, it was a sacred duty to those who had lost their lives in gaining such important results to do them the justice and honour of bringing them to light.

Mr. J. J. Murphy read a paper containing *A Proposal for the Establishment of a Uniform Reckoning of Time over the World, in connection with the Electric Telegraph.* The period in all probability was not remote when the telegraph would effect an almost instantaneous communication between parts of the world which were separated by an extensive arc of longitude, and differed in their solar time by several hours. The system which was introduced all over Great Britain, of keeping Greenwich time could not be applied over extensive arcs of longitude. A difference of half an hour between solar time and clock time at any place was no inconvenience, but a difference of six hours would be much too great. It would be necessary for distant places to continue to keep their local solar time; but in order to time the receipt and dispatch of telegraph messages, it would be necessary either to reduce the time of one place to that of any time for all. Mr. Murphy proposed a simple self-acting method for meeting the requirements of the case. Let every electric telegraph station that communicates with distant stations be furnished with a clock, similar in other respects to a common clock, provided with a double circle of figures on the dial, the inner circle being fixed as in the common clock, but the outer one being capable of being moved round. Let some one meridian, say that of Greenwich, be chosen as that to which all others shall be referred. Let every such clock throughout the world indicate Greenwich time on the inner or stationary circle of figures; but when a clock is set up at any station, let the outer circle be moved round and set, so that while the hour hand shows Greenwich time on the inner circle, it may show local solar time on the outer circle. The perfect convenience of this plan is obvious. It reconciles the necessity of keeping local time with the advantage of uniform time, and gets rid of any trouble in reducing the one to the other. The system might be rendered more workable still by abolishing the distinction of east aud west longitude, reckoning either all east or all west from 0 to 360, and by abolishing the distinctions of a. m. and p. m., reckoning time from midnight up to 24 o'clock.

Section B.—Chemical Science.

Dr. Daubeny gave an account of *a New Method of Refining Sugar*, conducted at Plymouth by Mr. Oxland, and known by his name. It consists in the adoption of the superphosphate of alumina in conjunction with animal charcoal, as a substitute for the albumen usually employed for that purpose. In both cases the object is to separate and carry down the various impurities which colour and adulterate the pure saccharine principle present in the syrup expressed from the cane or other vegetable which supplies it. As, however, bullock's blood is the material usually procured for the purpose of supplying the albumen, a portion of uncoagulated animal matter, together with certain salts, is left in the juice in the ordinary process of refining, which impairs its purity and promotes its fermentation—thus occasioning a certain loss of saccharine matter to result. Nothing of the kind happens when the superphosphate is substituted, and so much more perfect a purification of the feculent matters, under such circumstances, takes place, that several varieties of native sugar, which, from being very highly charged with feculent matters, are rejected in the ordinary process of refining, are readily purified by this method The employment of superphosphate of alumina also gets rid of so much larger a portion of the impurities present in the sugar, that much less animal charcoal is subsequently required for effecting its complete clarification than when bullock's blood has been resorted to. The quantity of superphosphate necessary for effecting the object is, for ordinary sugars, not less than twelve ounces to the ton; whereas, for the same quantity, as much as from one to four gallons of bullock's blood is found to be required. Dr. Daubeny suggested that this re-agent might be advantageously resorted to not only in the purification of sugar, but also in other processes of the laboratory, when the removal of foreign matters, intimately mixed with the solutiou of a definite component, becomes a necessary preliminary in its further examination.

Mr. R. L. Johnson then read a paper *on Illuminating Peat Gas.* He stated that it is now nearly half a century since a Parliamentary Commission appointed by Government to report on Irish peat, named the town of Sligo and the Hill of Howth as the extreme points of a straight line, and Galway and Wicklow Head as the extreme points of another straight line, between which two straight lines lay the six sevenths of all the peat in Ireland,

the remaining one seventh being distributed throughout localities on either side of these lines. Having named the different localities where peat is distributed, the total number of which in acres appears to be three millions, Mr. Johnson entered into a detailed description of the mode by which he obtained illuminating gas from common peat or turf, which he produced by the double decomposition of the constituents of the peat. He stated that works for the production of gas have been recently erected, and are in actual operation in two plaees in Ireland. The gas was good, and its cost, as stated to him by a gentleman who was using it, less than two shillings the thousand cubic feet. He stated that from one single pound weight of common peat an hour's light may be produced, and that, its cost being so very small, it should ultimately be extensively used throughout Ireland, and in its production there was one third of charcoal.

Professor Sullivan corroborated Mr. Johnson's statement, and said that he saw the gas produced when the experiments were going on, and that it appeared good; and from what he had seen and heard from men who gave the study of peat considerable attention, Mr. Johnson had succeeded in producing a cheap and good light from a heretofore valueless though abundant source.

Professor CAMERON read a paper *on Urea as a Direct Source of Nitrogen in Vegetation.* He showed that nitrogen was also available, as food for plants, when a constituent of urea, as in its ammonial combination; or, in other words, that urea, without being converted into ammonia, may be taken up into the organisms of plants, and there supply the necessary quantity of nitrogen. He described the experiments which led him to this conclusion, which were very elaborate, and were made on barley plants in confined spaces supplied with air freed from ammonia. The following conclusions were deducible from the result of his experiments, viz.:—1. That the perfect development of barley can take place, under certain conditions, in soil and in air destitute of ammonia and its compounds. 2. That urea in solution is capable of being taken unchanged into the organisms of plants. 3. That urea need not be converted into ammonia before its nitrogen becomes available for the purposes of vegetation. 4. That the fertilizing effects of urea are little if at all inferior to the salts of ammonia. 5. That their exists no necessity for allowing drainings or other fertilizing substances containing urea to ferment, but that, on the contrary, greater benefits must be derived from their application in the recent or unfermented condition.

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Mr. J. W. Rogers read a paper *on the Chemical Properties of the Potato, and its Uses as a General Article of Commerce if properly manipulated.* The object of this paper was to show that the matter of the potato was in reality equal in nutritive value to the dry matter of wheat, whilst the quantum of food produced from a given quantity of land was nearly four times that produced from wheat. He exhibited some very interesting specimens of the production of the potato in meal, flour, &c., and gave the following results of analysis :—

	Starch.	Gluten.	Oil.
Components of the potato per cwt.	84.077 lb.	14.818 lb.	1.104 lb.
Do. of wheat, do.	78.199 "	17.536 "	4.265 "

And gave the following results as to the quantum of food from an acre of land :—

	Starch.	Gluten.	Oil.
Dry matter of potato, - - - -	3427 lb.	604 lb.	45 lb.
Dry matter of wheat, - - - -	825 "	185 "	45 "

The concluding communication was made by Dr. Gilbert being *a Preliminary Notice of Researches on the Assimilation of Nitrogen by Plants, by Messrs. Lawes, Gilbert, and Pugh.* The great importance of settling the question, Whether or not plants can assimilate the free nitrogen of which the atmosphere to such an extent consists? was first insisted upon. In a purely scientific point of view the question was of high interest, and if answered in the affirmative this would add a very striking fact to the history both of nitrogen itself and of the vegetable functions. A true theory of many agricultural facts and practices also required a definitive solution of this debated point. Earlier writers supposed that the free nitrogen of air could be taken up by plants. De Saussure and others came to an opposite conclusion; and this latter view had been pretty generally adopted by scientific obcervers. Boussingault in particular had brought experimental evidence to show that plants did not assimilate the nitrogen of the air. But during the last few years a most elaborate and extensive series of investigations had been made by M. G. Ville of Paris, the results of which led him to conclude that plants assimilated a considerable amount of free nitrogen. M. Boussingault had followed up the inquiry in various ways, and still maintained the opposite opinion. It was hence of the highest importance that a third party should undertake the subject, and it was to this end, and the results so far obtained, that the authors brought

their plan for discussion before the Section. They described the several methods adopted by MM. Boussingault and Ville, and then illustrated by drawings their own methods and results. In all cases the plants were growing in soil and atmosphere destitute of all combined nitrogen in the first instance. To some, however, as their growth seemed to indicate the need, small and known quantities of ammonia were added. Drawings of the progress of the plant showed an enormous increase of growth where the ammoniacal supply was given. In these cases the plants promised to yield seed, and their height and general development was pretty natural. In the other instances, owing to the combined nitrogen of the seed sown and the free nitrogen of the air the plants were exceedingly small, and withered before coming to perfection. The final result, however, could not be known until the growing plants, the soil, and the pots in which they grew were analysed, when the debtor and creditor account, so to speak, of the nitrogen could be made up. Other researches were also in progress to determine the relation of the gases evolved during the growth of plants, to the constituents actually assimilated.

Section C.—Geology.

General Sketch of the Districts already visited by the Geological Survey of India. By Thomas Oldham, A.M., F.R.S., G.S., &c., Superintendent of Geological Survey of India.

The labours of the Geological Survey of India have been conducted hitherto under great difficulties. More recently, however, the liberality of the Government of India had greatly extended the establishment of the survey, and he trusted that their future progress would be rapid and effective. The only general sketch-map of the geology of India which they had was that published by the late Mr. Greenough. This was a work of great value, and gave abundant proof of the extent and labour of its author in its compilation. As might be anticipated under the circumstances, it was full of errors; and perhaps few could speak more confidently of this than himself. But at the same time it was a most valuable contribution, and would prove a most useful guide to future observers. The officer of the geological survey had examined several districts of considerable area in detached positions, and the results which he was able to lay before the section might therefore appear less connected than he could wish. But every day would tend to unite them more closely; and his object was now

simply to report progress, and to show that something had been done to elucidate the structure of India. Referring first to the districts to the east of the Bay of Bengal, the Tennasserim Provinces extend for about six degrees of latitude along the east shores of the Bay of Bengal. In breadth they seldom exceed more than one degree of longitude. From Siam, on the east these provinces are separated by an interrupted range of mountains, occasionally rising to 7000 or 8000 feet high, but the general height of which is to the north about 4000, diminishing in passing southwards to 3000 feet or less. The main direction of this range is north and south: this being also the general direction of the coast line, of the minor and outlying ranges of hills, and, therefore, of the rivers. The geological structure is tolerably simple, although at first sight apparently complicated, from the great disturbances to which the Rocks have been subjected. The central range is of granite, occasionally, but not frequently of syenitic character; itself traversed by thick veins of large crystaline felspathic granite, and often along its outer edges, or near its junction with overlying slates, characterized by the presence of tinstone as an ingredient of the mass disseminated among the other mineral constituents. This granite axis is succeeded by highly metamorphic rocks of gneissic and micaceous character, themselves cut up by numerous veins of granite, which, however, do not extend far from the junction. Upon these is a great accumulation of bluish and bluish-black earthy beds, thinly laminated, of thin-bedded grits, and of pseudo-porphyritic rock, the normal character of which is an earthy hard rock with small irregularly disseminated sub-crystaline felspar, passing, on the one hand, into slates, and, on the other, into grits, often coarse and conglomeritic. These harder rocks form all the higher grounds of the outer ranges of hills. This series being best seen in the southern province of Mergin, has been provisionally called the "Mergin" series. The total thickness is about 9000 feet. It is succeeded uncorformably by hard sandstones in thick and massive beds, with their earthy partings, generally of reddish tints, occasionally deep red and yellowish. A few beds are slightly calcareous, and in the upper portion a few thin and irregular bands of earthy blue limestone occur. Above these rest about 200 feet of soft sandstone in thin beds, upon which apparently rests the massive limestone of the country so largely seen near to Moulmien. The thickness of the ntire group is about 6000 feet, and as some of its members are

but seen in the northern province of Moulmein, I have provisionally called it the "Moulmein" series. To determine the age of the older of these two groups (the Mergin) we have no data. The aspect of much of the rocks is very similar to the trappean ashes and felstones so abundant in the silurian rocks of this country, while others are lithologically like Devonian; but these resemblances are very deceptive. The age of the Moulmien series is, however, tolerably defined by its organic contents. These appear to fix the age of the group as distinctly carboniferous. The whole of these rocks were, subsequently to their induration and disturbance, widely and greatly denuded, and on their upturned edges at intervals is found a series of conglomerates and sandstones and imperfectly coherent shales, with thick beds of coal, generally of lignitic character. None of the conglomerates are coarse; the sandstones are fine, gritty and pebbly, or clean white quartzose grits; the shales thinly laminated; the coal itself thinly disposed in thin flaky laminæ, with earthy streakings marking its structure. In addition to the total unconformity of these rocks, the imbedded organic remains are quite distinct. They consist of dicotyledonous plants (leaves) belonging to the group of the Laureaceæ, and probably to the genus Laurophilum of Goppert. In the thin papery shales which overlie the coal are also remains of fish (scales, &c.) of fresh-water character; the whole referring the beds to a very recent epoch, probably corresponding in part to the pliocene of European geologists. It is curious to notice here the absence of any coal in the carboniferous rocks below, and its abundant presence in those newer beds. The total thickness of these beds does not exceed 900 to 1000 feet. They are never continuously traceable; they occur heaped up against and separated by the projecting ridges of the higher ground, and must have been deposited when the physical conformation of the country was very similar to that now existing. They appear to be the result of a series of fresh-water deposits, formed in small lake-like expansions along the lines of the great drainage valleys of the country, and to mark a line of general and greater depression between the main ridge of hills dividing Siam from the British dominions, and the outer ridges which occur between this and the sea. The direction of the main drainage of the county is determined, as already remarked, by the direction of these ranges, and is discharged into the sea through narrow rocky gorges, which have a direction nearly into the east and west, aud which are due to lines of break-

age and dislocation. To this is due the sudden alteration in the direction of the courses of the larger rivers, as may be seen on maps. Rocks similar to those situated in the Tenasserim provinces extends northwards up the course of the Salween River, and into the adjoining districts of Burmah, to the north-east of Pegu. And, again, close to the capital of Burmah, and stretching nearly north and south, as far as examined, high ridges of metamorphic rocks are again met with, consisting of gneiss, micaceous schists, and highly crystalline limestones, occasionally of a fine white colour, and largely used by the Burmese for sculpture. But the great valley of the Irrawady is, throughout a very large extent of its course, bounded on either side by a thick series of rocks, chiefly sandstones, but with massive limestones also, which are locally rich in fossils, and which, from this evidence, may be clearly referred to the eocene period. These stretch on both sides of the river as far north as Pugahu, beyond which the higher grounds recede from the river banks; but they are in all probability continned thence into Munipoor, and so uuited with the nummulitic rocks of the Khasi and Cachar Hills. These rocks have been considerably disturbed and broken, but have a general and prevailing strike nearly north and south, which strike, throughout many miles, has determined the general course of the River Irrawady Their thickness is considerable, certainly exceeding 5000 feet. Above these eocene rocks, and resting upon them with slight unconformity, is a series of beds of no very great thickness, characterized by an abundance of gypsum disseminated in the layers and veins, and in the lower beds of which occur the deposits of clays and of vegetable matter, from which are derived the larger supplies of petroleum. These rocks are well seen at Senan Kyoung ("stream of fœtid water") and are traceable northwards to near Amarapura. In the beds which appear to form the uppermost part of this group, but which may possibly belong to another and distinct series, are found some of the fossil bones of the larger animals which occur abundantly in this district. About forty miles north of Amarapura we again meet with sandstones, shales, and coal, resting uncomformably on the metamorphic rocks, and characterized by remains of dicotyledonous trees similar to, if not identical with, those found in the coal-yielding group of the Tenasserim provinces, and which are therefore referred to the same age (pliocene). This series, so far as examined, proved of no great extent or thickness. We pass now to the Khasi Hills, which form a

comparatively isolated range, rising suddenly from the great plains of Bengal in the south, and divided in the north by the valley of Assam from the great Himalaya or Bhotan range. On the southern face of this range rises almost perpendicularly from the plains, which are continual from the Bay of Bengal, with scarcely a perceptible change of level to the very foot of the hills, and, with the exception of a comparatively small thickness of metamorphic rocks at the base, are composed of nearly horizontal beds of sandstones, a few shaly layers and limestone, long known for the abundanee and beauty of the nummulites it contains. These beds dip slightly to the south, and die out towards the north, when the metamorphic rocks come to the surface in the hills. Disregarding here any details as to the older rocks, the age of the sand stones and limestones is unquestionably fixed by their organic contents, and therefore, also, the epoch of the coal, which is associated with them, as belonging to the great eocene period of geologists. No newer group, of rocks is definitively seen in these hills. Along the southern face of the range there is evidence of a great dislocation extending for many miles, and possibly along the entire scarp, which has brought down to the level of the plains the rocks which are seen at the top of the hills. This line of dislocation has in all probability tended to give the nearly rectilinear direction of the escarpment; its date is fixed as at least subsequent to the formation of all the eocene rocks here seen. An older group of sandstones, considerably altered, is seen further to the north, within the hills, and also a series of highly metamorphosed schists and grits resting upon the gneissic and granitic rocks; but the details of these are reserved. Passing thence still further to the north and east, at the base of the Sikkim Himalayas, under the hill station of Darjiling, another section was described. The great mass of the lofty hills is here composed of schistoze rocks of various characters, considerably disturbed and contorted. These, although hitherto coloured similarly, and considered as of the same age, were decidedly different from, and more recent than, the gneissoze rocks of the greatest portion of India. Near the base of the hills, and faulted against these rocks at high angles, there is a small extent of sandstone and black shales, which contain vertebrata, pecopteris, &c., similar to those occurring in the great coal-fields of Bengal These fossils are peculiarly interesting, from the fact of their being changed into graphite, and occurring in beds which themselves

have a very strongly marked graphitic character. They are of very limited extent; the greater portion of the sandstones, which in this section exhibit a thickness of some thousand feet, belonging to a series of much more recent date, and which has been subjected to a much smaller amount of disturbance and alteration. The exact relation of these, too, it has not been possible to observe. This upper group contains many large stems, in all observed cases prostrate, and in most cases giving evidence of great wear and long exposure previously to being imbedded; and in some of the finer and more earthy deposits an abundance of leaves occur, of the same general character as those already noticed as occurring in Bunah and Tenasserim. This group was therefore provisionally referred to the same age (pliocene). No traces of the great nummulitic series had been observed in this district. In the more central portions of India three very large districts had been examined, to which he would now refer. One of these was to the south of Calcutta, in the district of Cuttack; the second included all the country between the great coal-field of the Damoodah, which had previously been mapped by Mr. Williams, and the River Ganges, extending northwards to Rajmahal and Bhagulpore; and the third extended along the valley of the Nerbudda from west of the Hosungabad to many miles east of Jubbulpur. For the details of the first of these he was indebted chiefly to his able assistants, the Messrs Blandford; for the last to Mr. Jos. Medlicott, who had very zealously worked it out, having to carry on the formation of a topographical map at the same time. In all these cases the sedimentary rocks, to which he would refer, formed portions of a series once more widely extended, and probably continuous ove the whole country, now separated by denudation, from removal by which they have been in great part protected, by being faulted into and against the highly metamorphose gneiss, &c., which surround them. The Talcheer field extends for about 70 miles from east to west, with an average breadth of 15 to 20 miles. and is bounded both on the north and south by great parallel faults, the former of which has an agregate throw of upwards of 2000 feet; these faults are not truly east and west, but to the south of east and north of west. The section in ascending order of the basin shows at the base sandstone and blue shale, but slightly fossiliferous in thickness from 500 to 600 feet; over these is a series of shales and sandstones often micaceous, occasional beds of ironstone and thin lays of coal and coally shale, giving a total thickness of

about 1800 feet; and over these again is a distinct series of quartzose grits, conglomerates, and sandstones, in thickness from 1600 to 2000 feet. These three groups are unconformable each to the other; the unconformity between the two lower being, however much less marked than that between the two upper. To the lower group, as having been first recognised and described in this district, the name of "Talcheer" series has been given; the second group, which, from its imbedded vegetable remains, was proved to be identical with the rocks of the extensive Damoodah coal-field when these were first described, has been denoted the "Damoodah" series; while the upper group, supposed to represent the great series of rocks, so magnificently seen in the Mahadeva Hills of Central India, has been called the "Mahadeva" series. Thus these series can be recognised in each of the extensive fields referred to, although with varying developments and thicknesses. At the base of the Talcheer series there is a remarkable bed, consisting of very large and only slightly rounded masses of granite and gneiss, imbedded in a fine silt, and occurring under such conditions as induce the opinion that the action of ground ice has been the cause of its formation. In the Rajmahal district there is a very limited development of the lower beds, above which unconformably comes the Damoodah series, here exhibiting a greater extension upward than in Cuttack; but unfortunately the sequence of the rocks is interrupted by the intercalation of several successive floes of basaltic trap, the intervals between which have been marked by the continued and tranquil deposition of the mechanical rocks going on. These floes have been repeated six or seven times, and the phenomena of contact are in all cases marked; the upper layers of the mechanical deposits in contact with the trap being in all cases greatly altered, while the lower layers are in no cases changed, but rest unaltered on the degraded surface of the underlying trap. But while the actual physical sequence of the deposits cannot be here traced, the fact of their all belonging to the same great series is attested by the occurrence of some identical fossils throughout. A few species pass upwards through the series, but there is a very marked change in the general facies of the flora in the upper as compared with the lower portion of the group; the latter characterized by the abundance of vertebrata, pecopteris, trizzgia, &c., the former by the abundance of zamia-like plants. The series, therefore, has been divided into Upper and Lower Damoodah rocks. For the details of the struc-

ture of the district, reference was made to the maps. In the Nerbudda district the series was less interrupted, and there also the same general results were obtained. The southern boundary of this great field was for a large part of its course produced by a great fault, having, *quam proxime*, the same general direction as that of the faults bounding the Talcheer field. The age, geologically considered, of these Damoodah rocks was briefly referred to. A large series of drawings of the fossil plants from them were exhibited, and the fact of the general oolitic facies of this group, especially of those from the upper beds, pointed out. The difficulty of the question was alluded to, especially in connection with the discovery, on the one side, of several species identical with those found in these Indian rocks in the Australian coal-fields, associated with numerous animal remains distinctly referable to the lower carboniferous era, and, on the other hand, to the discovery in Cuth of other species, also identical with some of these Indian forms, in beds associated with animal remains, undoubtedly referable to the oolic epoch. It must, however, be borne in mind that the latter forms, or those which the evidence of associated animal remains would show to be oolitic, are only found in the upper beds of the Damoodah series, while those which are common to the Australian fields are those chiefly found in the lower beds. Unfortunately, no animal remains whatever have been found with these plants in the districts examined. excepting some annelide tracts useless as distinctive forms. He preferred, under these circumstances, waiting for further evidence before giving any definite opinion as to the age of this widely-extended and important group of rocks. Mr. Oldham then stated that there seemed good reason for separating altogether from the several groups of rocks to which he had referred the whole of the great thickness of sandstones which formed the great Vindhyan range, extending almost entirely across India, from the mouths of the Nerbudda to the Ganges at Monghyr. These appeared to be of prior date, and there was a probability that there was a great line, or a group of lines, of dislocation passing along the general line of the valley of the Nerbudda, and the effects of which might be traced over a very large area, extending towards the north-east possibly even into the Valley of Assam. Besides the examination of these districts, which together included an area of more than 30,000 square miles, the geological survey had been able to add to the knowledge of the structure of the country in other ways.

An excellent selection of fossils from the neighbourhood of Verdchellum in Madras, for which they were indebted to Brooke Cunliffe, Esq., who had been associated with the Rev. Mr. Cay in the first examination of these fossils, had enabled them to add largely to the lists of Forbes, and to establish more conclusively than before the cretaceous age of these deposits. The exertions of Captain Keatinge at Mundlaiser, to whom Mr. Oldham had pointed out the interest of the inquiry, had collected a good set of organic remains from the limestone at Bang, to the west of Mhow, which had enabled him to fix the age of those deposits as contemporary, or nearly so, with the cretaceous beds of Trichinopoly and Verdachellum. This discovery gives rise to many important speculations as to the age of other beds, and also as to the epoch of the elevation of all Central India, but more data were required before these could fairly be entered upon.

SECTION D.—ZOOLOGY AND BOTANY, INCLUDING PHYSIOLOGY.

DR. DAUBENY read a *Final Report on the Vitality of seeds*. He stated that about sixteen years since Mr. Strickland and others and himself suggested the advisability of instituting experiments for the purpose of ascertaining, by way of experiment, as far as possible, the terms to which different seeds would retain their vitality. They were all well aware of the statement as to the germination of mummy seeds, and it was with the view of determining the various questions which arose that a commitee was formed in 1840 to make experiments, which were made in the following manner :—A considerable number of seeds of as many kinds as could be procured were placed in porous stone jars, covered so as to exclude insects and rapid circulation of air, and so as to secure a slow circulation. The experiment had been carried on for seventeen years, and each year a report was given, stating the number of seeds which had germinated, which were resown until their vitality ceased. As the seeds which had originally been procured had, with the exception of four, lost vitality, the inquiries were considered to have come to a close, and the final report was brought forward. He submitted a paper to the meeting containing a general summary of the experiments from 1841 to 1857, and a tabular statement, showing the relative vitality of different kinds of seeds, from which it would be seen that the greater number of seeds lost their vitality at eight years, and that forty-three years was the longest period to which they retained it. The experi-

ments made by the Association did not confirm the common belief regarding the indefinite vitality of certain seeds, for instance, the mummy seed. If any naturalist would suggest a better mode of preserving the plants, it would be well to institute a new set of experiments; but as far as was at present known, the plan that was adopted was the most likely to preserve their vitality.

Professor GEORGE WILSON read a paper on the *Employment of the Living Electric Fishes as medical Shock Machines*, of which the following is an abstract:—The author, in prosecuting inquiries into the early history of electrical machines, did not originally contemplate going farther back than the seventeenth century, or commencing with any earlier instrument than that of Otto Guerick. His attention had been turned to the living torpedo as a remedial agent, and he now felt satisfied that living electrical fish were the most familiar and earliest electrical instruments employed by mankind. He adduced the testimony of Galen and others in proof of the practice, and as proving that "shocks" had been used as a remedy in paralytic aud neuralgic affections before the Christian era. Still higher antiquity had been claimed for the electric Silurus, on the supposition that its Arabic name, "Raad," signified "Thunder Fish" and implied the nature of the shock; but the best Arabic scholars had shown that this was not the case. In proof of the generality of the practice of employing zoo-electrical machines, he alluded to the remedial application of the torpedo by the Abyssinians—of the gymnotus by the South American Indians, and the recently discovered electrical fish by the dweller, on the Old Callabar River, which falls into the Bight of Benin. The native women, he said, had a habit of keeping one or more of those fishes in water, and of bathing their children therein with the view of strengthening them by the shocks which they received, which were very powerful. Having observed on the proofs of the antiquity as well as generality of the practice under notice, he concluded by directing the attention of naturalists to the probability of additional kinds of electrical fishes being discovered, and to the importance of obtaining the views of the natives familiar with them in reference to the sources of their therapeutic employment.

DR. REDFERN read a *Notice of a Simple Method of Applying the Compound Microscope to the examination of the Contents of Aquavivaria.* He stated that he had for some time made use of a very simple and convenient arrangement for examining objects

in aquaria with magnifying powers up to those given in the half circle objective. It consisted of a vertical stem of one-inch brass tubing, about two feet long, supported by a heavy cast-metal foot. In this stem a three-inch piece of tube slides, and is supported at any height by a ring and pinching screw below it. This short sliding table has another like piece attached to it, and rotating on an axis at right angles to the vertical stem. Through this second piece a tube, two feet long, slides horizontally, its best working position being such that three-fourths of its length projects on one side of the vertical stem, and the other fourth on the opposite. To the shorter end of this horizontal tube a stem, carrying the tube of the body of the microscope, is attached by a ball-and-socket joint, admitting of a coarse adjustment by a sliding tube, and of a fine adjustment by acting on the long arm of the lever formed by the transversely sliding tube to the end of which it is attached. By this means the compound microscope is capable of being applied to any part of the surface of the side of an aquarium measuring two feet, or to the surface of the fluid which it contains. The whole arrangement can be made by a gas-fitter for the sum of about 25s., with sufficient accuracy for the uses for which it was designed. Abundant illumination may be obtained in cylindriform vessels by a small flat mirror let down into the aquarium, and moved into any position by wires, which can be attached to it in a very simple manner.

EDITORIAL NOTICE.

The readers of the Journal are informed that each number of the coming volume will contain a summary of Scientific Intelligence, in which the various departments of Natural History will be considered under their respective heads.

MONTHLY METEOROLOGICAL REGISTER, AT MONTREAL, (LATITUDE 45° 30′ N., LONGITUDE 73° 36′ W.,) FOR THE MONTH OF DECEMBER, 1857.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Force of the Wind, from 0, Calm, to 10, Violent Hurricane.			Amo'nt of Rain in Inches.	Amo'nt of Snow in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.			Observations.
	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.	
1	29·974	29·907	29·914	40·5	43·0	37·8	·225	·209	·157	·91	·75	·71	S 2	S W 2	S W 4	0·29	......	Nim. 10	Cu. St. 7	Cu. St. 9	
2	969	948	798	36·5	41·0	38·0	·170	·212	·165	·80	82	·72	S W 2	S W 1	S W 1	......	......	Nim. 10	Cu. St. 8	Cu. St. 8	
3	749	850	30·016	36·0	29·9	24·0	·120	·123	·094	61	77	73	W S W 2	W S W 1	W S W 1	......	Inap.	Nim. 10	Cu. St. 10	Cu. St. 10	
4	30·057	30·054	106	23·0	24·0	15·0	·073	·077	·040	59	60	46	N W 1	W N W 1	N N W 2	......	Inap.	Cu. St. 10	Strat. 6	0 0	Bright Zodiacal Light. Diffused Auroral Light.
5	170	212	258	9·0	12·0	12·0	·051	·045	·045	65	60	60	N E 1	N E 1	N E 1	......	......	Strat. 1	Cir. 1	0 0	" " " " "
6	249	344	29·723	7·0	17·0	30·3	·045	·047	·148	64	50	89	N E 1	N N E 1	N N E 2	......	......	0 0	Cu. St. 10	Nim. 10	
7	29·632	29·803	916	39·0	42·0	37·2	·195	·199	·157	82	74	71	S W 4	W 2	W 4	Inap.	Inap.	Cu. 4	0 0	0 0	Bright Zodiacal Light.
8	829	919	30·156	36·0	43·0	32·0	·191	·186	·143	90	67	79	W S W 2	W 2	S 1	......	......	Cu. St. 10	Strat. 1	0 0	Zodiacal Light.
9	30·111	773	29·495	29·4	33·8	39·0	·123	·168	·216	77	89	91	W 3	E 1	S 1	......	......	Cu. St. 10	Nim. 10	Nim. 10	
10	29·521	510	678	39·0	37·0	27·0	·216	·136	·093	91	62	63	W 2	W 2	W 2	Inap.	1·20	Nim. 10	Cu. St. 10	Nim. 10	
11	30·096	30·247	30·389	15·0	15·5	11·0	·063	·031	·028	67	37	39	N N W 2	N W 2	N W 2	......	......	Cu. St. 9	Cu. 6	0 0	Zodiacal Light. [of the 13th.
12	441	471	388	12·0	23·0	25·5	·045	·098	·100	60	72	74	W 2	W 2	W 4	......	......	Cir. St. 8	Cu. 5	0 0	Faint Zodiacal Light. High Wind at its maximum between 5 & 6 A. M.
13	219	091	29·938	25·6	37·0	36·0	·123	·178	·156	77	91	75	S W 7	S W 6	S W 4	......	......	Cu. 9	Cir. Cu. 8	Cu. St. 3	
14	29·925	29·966	30·134	39·0	40·5	37·5	·173	·197	·171	73	78	76	W 2	W 1	W 3	......	......	Cu. St. 10	Cu. St. 10	Cu. St. 9	
15	30·397	30·478	312	23·0	25·2	23·0	·106	·100	·106	86	74	86	N E 2	N E 2	N N E 3	......	......	Cu. St. 10	Cir. Strat. 6	Cu. St. 10	
16	227	238	274	23·5	30·5	27·5	·123	·142	·141	100	84	93	N 2	N 2	N 2	......	1·20	Nim. 10	Nim. 10	Cu. St. 10	
17	119	034	104	28·2	33·0	35·0	·153	·208	·183	100	91	90	Calm.	Calm.	Calm.	......	......	Nim. 10	Nim. 10	Nim. 10	
18	29·794	29·443	29·418	34·0	37·0	37·5	·193	·221	·221	100	100	100	N 2	N N E 2	N N E 2	0·31	......	Nim. 10	Nim. 10	Nim. 10	
19	909	30·128	30·300	22·5	19·5	15·8	·118	·097	·059	100	92	65	W N W 2	W 2	W 2	1·30	Inap.	Nim. 10	Nim. 10	Nim. 10	
20	30·421	462	491	12·5	14·6	12·0	·060	·046	·045	80	55	60	N W 2	W 3	W 2	......	Inap.	Cu. St. 10	Cu. 7	0 0	Faint Zodiacal Light. Aurora, with streamers.
21	412	216	062	17·4	27·2	20·0	·072	·093	·091	75	63	85	S 1	S 1	S 1	......	......	Cu. St. 10	Cir. 3	Nim. 10	
22	29·646	29·469	29·434	24·2	29·0	28·0	·129	·160	·117	100	100	76	N N E 1	N N E 1	N N E 1	......	4·00	Nim. 10	Nim. 10	Cu. St. 10	
23	502	341	30·268	14·0	25·0	28·0	·051	·082	·117	63	61	76	W 2	S 3	S 2	......	1·50	Strat. 3	Nim. 10	Nim. 10	
24	541	866	127	24·7	15·0	9·0	·105	·040	·022	80	46	35	N W [illegible]	N N W 3	N N W 3	......	3·50	Nim. 10	Cu. St. 8	0 0	Auroral Light.
25	30·120	30·057	29·958	4·5	11·5	7·0	·005	·036	·017	9	49	29	W N W 1	W N W 3	W N W 1	......	......	Strat. 0·5	Nim. 10	Nim. 10	
26	29·929	29·920	30·059	0·6	6·0	6·0	·020	·029	·029	43	51	51	N E [illegible]	N N E 2	N N E 1	......	......	Cu. St. 10	Cu. St. 10	Cu. St. 10	
27	30·267	30·194	144	−2·0	5·0	4·9	·006	·013	·013	12	23	23	N E [illegible]	N E 3	N E 2	......	......	0 0	Cu. St. 9·5	Cu. St. 10	Lunar Halo.
28	29·453	29·728	29·955	+20·0	35·0	30·6	·091	·183	·124	85	90	73	S W 1	W S W 1	W 1	......	4·50	Nim. 10	Cu. St. 9	0 0	Lunar Corona.
29	986	941	30·009	26·4	28·9	23·4	·099	·117	·051	69	76	40	W S W [illegible]	W N W 1	N W 1	......	Inap.	Cu. St. 10	Cu. St. 10	Cu. St. 8	
30	978	808	29·742	21·2	28·0	32·0	·096	·153	·181	85	100	100	N 1	N W 1	N W 1	......	......	Cu. St. 10	Nim. 10	Nim. 10	
31	271	28·994	292	31·3	27·0	31·0	·174	·147	·155	100	100	89	E N E [illegible]	N N E 2	W 3	......	15·00	Nim. 10	Nim. 10	Nim. 10	

REPORT FOR THE MONTH OF JANUARY, 1858.

Day	Barometer 7 a. m.	2 p. m.	9 p. m.	Temp. 7 a. m.	2 p. m.	9 p. m.	Tension 7 a. m.	2 p. m.	9 p. m.	Humidity 7 a. m.	2 p. m.	9 p. m.	Wind 7 a. m.	2 p. m.	9 p. m.	Rain	Snow	Clouds 7 a. m.	2 p. m.	9 p. m.	Observations
1	29·727	29·612	29·983	18·0	28·0	25·0	·067	·153	·117	·68	·100	87	S W 2	S W 2	W N W 1	......	5·00	Strat. 4	Nim. 10	0 0	Lunar Corona.
2	30·123	879	796	15·0	28·0	30·0	·055	·099	·130	·64	64	·78	W S W 2	W S W 2	S W 2	......	2·00	Cu. St. 3	0 0	Strat. 1	Zodiacal Light.
3	29·933	448	492	12·5	20·9	16·3	·030	·080	·074	41	71	83	N W 2	N W 3	S W 2	......	0·50	Cu. St. 10	Nim. 10	Cu. St. 5	
4	380	160	311	26·0	40·0	39·0	·111	·203	·173	81	82	73	S W 4	W S W 4	W S W 4	......	1·75	Cu. St. 10	Strat. 3	Cu. St. 4	
5	882	897	30·106	20·0	10·0	5·0	·091	·045	·013	85	68	23	N 2	N E 2	N E 4	......	......	0 0	0 0	0 0	Faint Zodiacal and Auroral Lights.
6	30·053	938	29·893	−0·2	6·0	5·0	·038	·029	·041	85	51	74	N E 3	N N E 4	N N E 4	......	......	Cu. St. 10	Nim. 10	Nim. 10	
7	040	30·214	30·486	+6·3	11·0	6·4	·043	·028	·029	75	39	51	W 2	N W 2	N W 2	......	5·75	Nim. 10	Strat. 4	Strat. 2	
8	687	708	579	1·0	7·0	2·3	·022	·038	·020	45	85	43	W N W 1	W N W 1	W S W 1	......	......	Cu. St. 9	Cir. 2	0 0	Brilliant Aurora. Faint Zodiacal Light.
9	181	29·914	29·993	16·0	25·0	31·0	·059	·082	·175	65	61	89	S 3	S S W 3	N W 1	......	......	Cu. St. 10	Nim. 10	0 0	Faint Zodiacal Light. Meteor perpendicularly from Auryga at 11·45 p.m.
10	254	30·394	30·346	19·0	19·4	18·8	·055	·065	·087	53	62	84	N W 1	W 1	W [illegible]	......	Inap.	0 0	[illegible] 0	0 0	
11	29·914	29·518	29·362	33·0	39·8	40·0	·188	·216	·248	100	91	100	S 6	S 4	S W [illegible]	Inap.	Inap.	Nim. 10	Nim. 10	Nim. 10	Auroral Bank.
12	558	30·094	30·352	35·0	24·2	17·0	·162	·094	·063	80	73	67	S W 6	W 1	W 1	0·11	......	Nim. 10	0 0	0 0	Faint Zodiacal Light.
13	30·255	29·954	052	5·0	18·0	26·0	·013	·036	·105	23	36	75	N 4	N E 3	W S W 2	......	......	Cu. St. 7	Cir. 8	Cu. St. 4	Faint Zodiacal Light.
14	217	30·292	396	24·6	30·0	23·4	·088	·111	·088	67	67	67	W 2	W 1	W 1	......	Inap.	Cu. St. 4	0 0	0 0	Faint Zodiacal Light.
15	456	222	29·996	11·0	16·0	17·8	·042	·059	·098	59	65	100	W 1	N E 1	E 1	......	......	Cu. St. 9	Nim. 10	Nim. 10	
16	29·584	29·419	540	35·0	30·0	32·5	·204	·167	·181	100	100	100	E 1	N E 2	N E 2	Inap.	2·50	Nim. 8	Nim. 10	Nim. 10	
17	835	969	30·043	17·8	14·0	10·0	·078	·051	·025	83	63	37	N E 1	N E 3	N E 2	0·11	0·50	Cu. St. 10	Cu. 3	0 0	Auroral Bank.
18	30·039	998	054	3·8	11·3	9·7	·024	·036	·039	47	49	57	N N E 1	N E 1	N N E 1	......	......	0 0	Strat. 2	0 0	Faint Auroral Light.
19	139	30·117	111	3·0	11·2	10·6	·022	·042	·039	45	59	57	N E 1	N E 1	N E 1	......	......	Fog.	Cu. St. 10	Cu. St. 10	
20	102	114	161	6·0	16·9	21·0	·029	·047	·074	51	59	64	N E 2	N E 2	N E 1	......	Inap.	Cu. St. 10	Cu. St. 8	Cu. St. 10	
21	051	29·855	231	25·5	37·0	20·0	·111	·154	·043	81	71	40	N 1	N E 3	N E 2	......	......	Cu. St. 8	Cir. 6	Cu. St. 2	Faint Auroral Light.
22	715	30·776	797	−1·4	1·0	−0·3	·028	·014	·023	68	34	53	N 3	N 3	N 2	......	......	0 0	0 0	0 0	Faint Auroral bank.
23	731	580	531	−13·0	4·0	+5·8	·018	·024	·029	42	47	51	N 2	N 2	N 1	......	......	0 0	0 0	0 0	Imperfect Lunar Halo, with Central Corona.
24	512	416	345	+0·3	34·0	23·0	·017	·077	·106	39	60	86	N 1	N 1	S 1	......	......	Strat. 1	Cir. St. 8	Cir. St. 8	Faint Solar Halo at 2 p. m.
25	279	201	101	32·2	38·0	37·0	·175	·229	·221	94	100	100	S 1	S 1	S 1	......	......	Nim. 10	Nim. 10	Nim. 10	
26	29·851	29·525	29·583	39·5	43·4	39·0	·235	·254	·238	97	92	100	S S W 1	S S W 1	S W 1	0·27	......	Nim. 10	Nim. 10	Nim. 6	
27	637	713	830	35·5	34·0	25·0	·177	·155	·100	85	79	74	W S W 1	N 1	N 1	0·03	......	Cu. St. 6	Nim. 10	Nim. 10	
28	868	829	873	20·8	21·9	17·0	·085	·070	·063	78	64	67	N E 4	N E 3	N E 2	0·02	......	Cu. St. 10	Cu. St. 10	Cu. St. 10	
29	853	774	757	16·0	24·0	22·0	·059	·077	·101	65	60	86	E N E 2	E N E 2	E N E 2	......	Inap.	Nim. 10	Nim. 10	Cu. St. 10	
30	734	701	835	20·9	25·0	13·0	·080	·100	·048	71	74	62	W N W 1	W N W 2	N W 2	......	......	Cu. St. 10	Cu. St. 10	Cu. St. 9	
31	30·049	30·098	30·210	−3·0	1·2	2·0	·012	·017	·020	32	39	43	W 7	W 3	W 1	......	......	0 0	0 0	Cir. 1	

REMARKS FOR DECEMBER, 1857.

Barometer. Highest, the 20th day: 30·491 inches; Lowest, " 31st " 28·994 "; Monthly mean, 29·9703 inches; Monthly range, 1·497 "

Thermometer. Highest, 1st day: 47°0.; Lowest, 27th " −5°0.; Monthly mean, 25°05.; Monthly range, 52°0.

Greatest intensity of the sun's rays, 86°7.
Warmest day was the 1st, its mean temperature being 40°43.
Coldest " " 27th, " " " 2°63.
Mean of humidity, ·719.

Rain fell on 5 days during 47 hours 30 minutes, amounting to 1·90 inches. Snow fell on 13 days during 81 hours 30 minutes, amounting to 30·9 inches in depth. The latter melted and added to the rain afforded a total of the former equivalent to 8·86 inches.
The most prevalent wind was the W.
The least prevalent wind was E. N. E. and E.
No record of wind from the E. S. E., S. E., S. S. E., and S. S. W.
The most windy day was the 13th.
The most windy hour between 5 and 6 A. M. of the 13th.
There was one calm day, the 17th.
There was no cloudless day.
Ozone was in moderate proportion.

N. B.—The rain and snow guages are noticed each morning at 10 a.

REMARKS FOR JANUARY, 1858.

Barometer. Highest, the 22nd day, 30·797 inches.; Lowest, " 4th " 29·160 "; Monthly mean, 30·0226 inches.; Monthly range, 1·497 "

Thermometer. Highest on the 26th day, 49°0.; Lowest " 23rd " −14°0.; Monthly mean, 18°83.; Monthly range, 63°.

Greatest intensity of the sun's rays, 79°.
Warmest day was 26th; its mean temperature, 40°63.
Coldest day was 23rd; " " −1·06.
Mean of humidity, ·6786.

Rain fell on 6 days during 56 hours 50 minutes. It snowed on 12 days during 52 hours 15 minutes. Of the former there fell 0·54 inches in depth; of the latter 17·95 inches. This melted and added to the former yielded a total of 3·81 inches rain in depth.
The most prevalent wind was the N. E.
The least " E.
No record of wind from N. N. W., E. S. E., S. E., and S. S. E.
The most windy day was the 11th.
The most windy hour between 4 and 5 a. m. of same.
There was no calm day.
Cloudless days occurred on 5th, 10th, 22nd, 23rd and 31st.
Ozone was in moderate proportion.

N. B.—The rain and snow guages are noted each morning at 10 a. m.